## 3.0 AFFECTED ENVIRONMENT

This section of the document describes the existing fishery and the resources that would be affected by this action. The physical environment is discussed in Section 3.1, the biological characteristics of the groundfish stocks and non-groundfish stocks interacting with the groundfish fishery are discussed in Section 3.2, and the socio-economic environment is discussed in Section 3.3.

### 3.1 PHYSICAL ENVIRONMENT

**California Current System.** In the North Pacific Ocean, the large, clockwise-moving North Pacific Gyre circulates cold, sub-arctic surface water eastward across the North Pacific, splitting at the North American continent into the northward-moving Alaska Current and the southward-moving California Current. Along the U.S. West Coast, the surface California Current flows southward through the U.S. West Coast EEZ, the management area for the groundfish FMP. The California Current is known as an eastern boundary current, meaning that it draws ocean water along the eastern edge of an oceanic current gyre. Along the continental margin and beneath the California Current flows the northward-moving California Undercurrent. Influenced by the California Current system and coastal winds, waters off the U.S. West Coast are subject to major nutrient upwelling, particularly off Cape Mendocino (Bakun, 1996). Shoreline topographic features such as Cape Blanco, Point Conception and bathymetric features such as banks, canyons, and other submerged features, often create large-scale current patterns like eddies, jets, and squirts. Currents off Cape Blanco, for example, are known for a current "jet" that drives surface water offshore to be replaced by upwelling sub-surface water (Barth, et al, 2000). One of the better-known current eddies off the West Coast occurs in the Southern California Bight, between Point Conception and Baja California (Longhurst, 1998), wherein the current circles back on itself by moving in a northward and counterclockwise direction just within the Bight. The influence of these lesser current patterns and of the California Current on the physical and biological environment varies seasonally (Lynn, 1987) and through larger-scale climate variation, such as El Niño-La Niña or Pacific Decadal Oscillation (Longhurst, 1998).

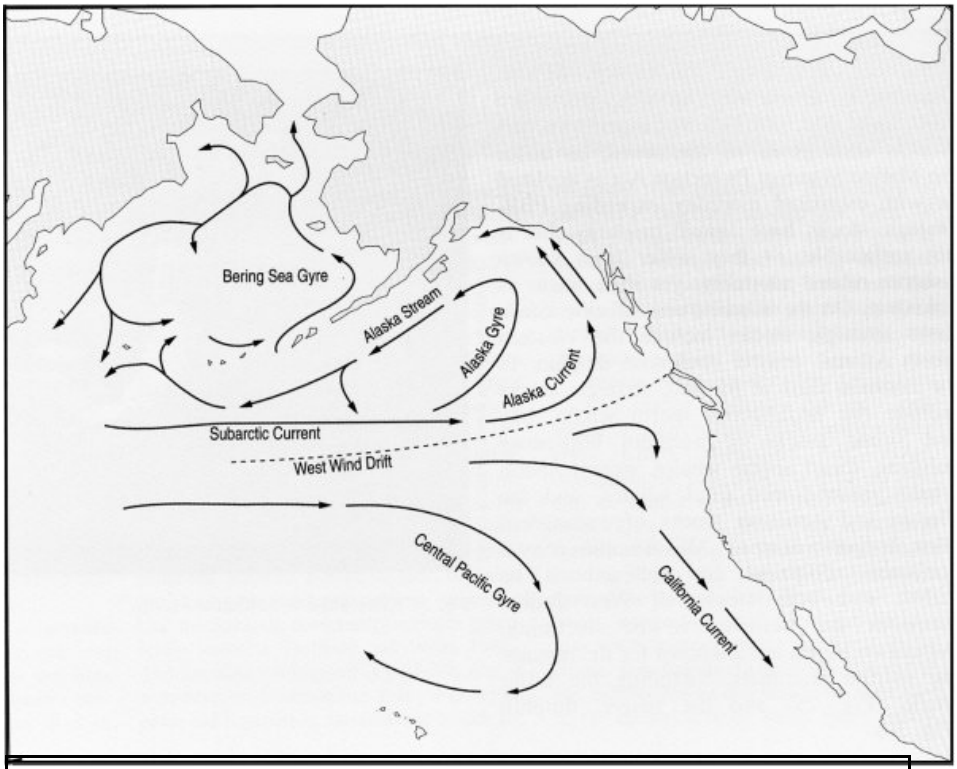



Figure 3.1.1 General circulation and current system of the North Pacific Ocean. NMFS

**Topography.** Physical topography off the U.S. West Coast is characterized by a relatively narrow continental shelf. The 200 m depth contour shows a shelf break closest to the shoreline off Cape Mendocino, Point Sur, and in the Southern California Bight and widest from central Oregon north to the Canadian border as well as off Monterey Bay. Deep submarine canyons pocket the EEZ, with depths greater than 4,000 m common south of Cape Mendocino.

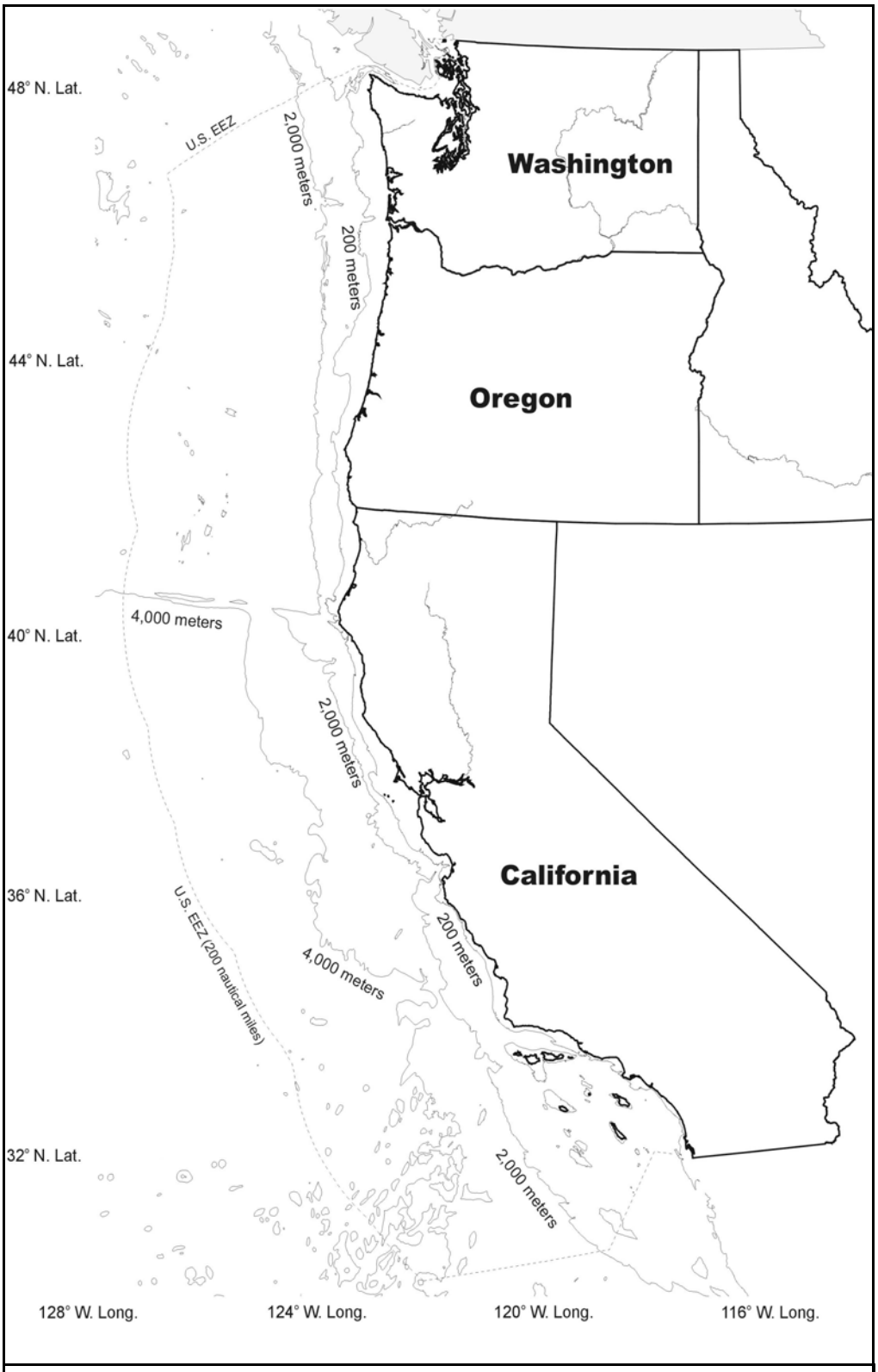



Figure 3.1.2 Bathymetric map of the U.S. West Coast EEZ: 200 m, 2000 m, 4000 m contours shown.

**Climate Shifts.** The physical dynamics and biological productivity of the California Current ecosystem have shown a variety of responses to both short- and long-scale changes in climate. For some groundfish species, these climate shifts may affect recruitment and abundance. El Niños and La Niñas are examples of short-scale climate change, six-month to two-year disruptions in oceanic and atmospheric conditions in the Pacific region. An El Niño is a climate event with trends like a slowing in Pacific Ocean equatorial circulation, resulting in warmer sea surface conditions and decreased coastal upwelling. Conversely, La Niñas are short-scale climate events characterized by cooler ocean temperatures (NOAA, 2002.) Long-scale Pacific Ocean climate shifts of two to three decades in duration are often called "Pacific (inter)Decadal Oscillation" or "PDO" in scientific literature. These long-scale climate shift events tend to show relatively cooler ocean temperatures in the Gulf of Alaska and Bering Sea ecosystems and relatively warmer temperatures in the California Current ecosystem, or a reverse trend of relatively warm temperatures in the north and cooler temperatures in the south (Mantua et al., 1997.)

Periods of warmer or cooler ocean conditions and the event of shifting from warm to cool or vice versa can all have a wide array of effects marine species abundance. Ocean circulation varies during these different climate events, affecting the degree to which nutrients from the ocean floor mix with surface waters. Periods of higher nutrient mixing tend to have higher phytoplankton (primary) productivity, which can have positive ripple effects throughout the food web. In addition to changes in primary production, climate shifts may affect zooplankton (secondary) production in terms of increasing or decreasing abundance of the zooplankton biomass as a whole or of particular zooplankton species. Again, these changes in secondary production ripple in effect through the food web (Francis et al., 1998.) Upper trophic level species depend on different lower order species for their diets, so a shift in abundance of one type of prey species will often result in a similar shift in an associated predator species. This shifting interdependency affects higher order species like groundfish in different ways at different life stages. In other words, some climate conditions may be beneficial to the survival of larvae of a particular species but may have no effect on an adult of that same species.

Population data on some species seems to show a link between climate and recruitment. Pacific whiting, for example, tends to have stronger year classes following an El Niño event than in other years (Hollowed et al., 2001.) There is also some evidence that sablefish recruitment may be affected by PDOs in that stronger year classes of sablefish tend to occur off British Columbia during decade-scale periods when ocean temperatures are relatively warm (King et al., 2000.) Although there are fewer analyses about the effects of climate on rockfish abundance coastwide, localized larval rockfish populations have shown lower survival rates in years when coastal upwelling and plankton production has been reduced by El Niño events (Yoklavich et al., 1996.)

Most of the scientific analysis on long-scale climate shift events has taken place within the past ten years. Recent public awareness of climate events like PDO, coupled with the relatively dramatic El Niño of 1997-1998 may create the perception that climate is the most significant contributor to marine species abundance. In an analysis of marine fish productivity in the Northeast Pacific Ocean, Hollowed, Hare, and Wooster found that links between marine fish recruitment and climate shifts were more clear for conservatively managed species (Hollowed, et al., 2001). For many of the depleted West Coast groundfish species, adult population levels may have a greater effect on the spawning productivity of the overall stock than climate shift events of either the short- or long-scale.

**Essential Fish Habitat.** The 80+ groundfish species managed by the FMP occur throughout the EEZ and occupy diverse habitats at all stages in their life histories. Some species are widely dispersed during certain life stages, particularly those with pelagic eggs and larvae; the essential fish habitat (EFH) for these species/stages is correspondingly large. On the other hand, the EFH of some species/stages may be comparatively small, such as that of adults of many nearshore rockfishes which show strong affinities to a particular location or type of substrate.

EFH for Pacific coast groundfish is defined as the aquatic habitat necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a

healthy ecosystem. Descriptions of groundfish fishery EFH for each of the 80+ groundfish species and their life stages result in over 400 EFH identifications. When these EFHs are taken together, the groundfish fishery EFH includes all waters from the mean higher high water line, and the upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon, and California seaward to the boundary of the U.S. EEZ.

The FMP groups the various EFH descriptions into seven major habitat types called "composite" EFHs. This approach focuses on ecological relationships among species and between the species and their habitat, reflecting an ecosystem approach in defining EFH. The seven "composite" EFH identifications are as follows:

1. Estuarine - Those waters, substrates and associated biological communities within bays and estuaries of the EEZ, from mean higher high water level (MHHW, which is the high tide line) or extent of upriver saltwater intrusion to the respective outer boundaries for each bay or estuary as defined in 33 CFR 80.1 (Coast Guard lines of demarcation).

2. Rocky Shelf - Those waters, substrates, and associated biological communities living on or within ten meters (5.5 fathoms) overlying rocky areas, including reefs, pinnacles, boulders and cobble, along the continental shelf, excluding canyons, from the high tide line MHHW to the shelf break (~200 meters or 109 fathoms).

3. Nonrocky Shelf - Those waters, substrates, and associated biological communities living on or within ten meters (5.5 fathoms) overlying the substrates of the continental shelf, excluding the rocky shelf and canyon composites, from the high tide line MHHW to the shelf break (~200 meters or 109 fathoms).

4. Canyon - Those waters, substrates, and associated biological communities living within submarine canyons, including the walls, beds, seafloor, and any outcrops or landslide morphology, such as slump scarps and debris fields.

5. Continental Slope/Basin - Those waters, substrates, and biological communities living on or within 20 meters (11 fathoms) overlying the substrates of the continental slope and basin below the shelf break (~200 meters or 109 fathoms) and extending to the westward boundary of the EEZ.

6. Neritic Zone - Those waters and biological communities living in the water column more than ten meters (5.5 fathoms) above the continental shelf.

7. Oceanic Zone - Those waters and biological communities living in the water column more than 20 meters (11 fathoms) above the continental slope and abyssal plain, extending to the westward boundary of the EEZ.

Life history and habitat needs for the 80+ species managed under the FMP are described in the EFH appendix to Amendment 11, which is available online at http://www.nwr.noaa.gov/1sustfsh/efhappendix/page1.html.

## 3.2 BIOLOGICAL ENVIRONMENT

### 3.2.1 Groundfish Stock Assessments; Resource Surveys and Biology of the stocks

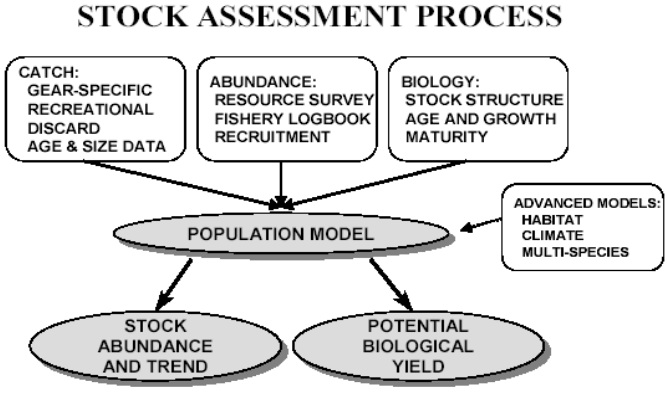
Data from resource surveys are combined with information derived from life-history studies and commercial landing statistics to calibrate models of groundfish population dynamics. These models are used to generate estimates of current abundance and fishing mortality levels, identify trends in abundance, and predict sustainable annual harvest levels for groundfish populations (Figure 3.2.2). The

Council considers output from the models when it establishes ABCs and setting annual harvest levels.

**Stock Assessments** Stock assessments for Pacific Coast groundfish are generally conducted by staff scientists of the California Department of Fish and Game (CDFG), Oregon Department of fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), Oregon State University (OSU), University of Washington (UW) and the Southwest, Northwest, and Alaska Fisheries Science Centers of NMFS. The purpose of groundfish stock assessments is to describe the condition or status of a particular stock. The result of a stock assessment is typically a report on the health of the stock, a forecast of biologically sustainable harvest levels, and/or other recommendations that would maintain or restore the stock. If a stock is determined to be in an overfished condition (less than 25% of its unfished biomass), a rebuilding analysis and a rebuilding plan are developed.

Over the past 20+ years, groundfish assessments have primarily been concentrated on important commercial and recreational species. These species account for most of the historical catch and have been the targets of fishery monitoring and resource survey programs that provide basic information for quantitative stock assessments. However, not all groundfish assessments have the same level of information and precision.

Quantitative and non-quantitative assessments are used for groundfish stocks. Stocks for which there are sufficient life history and fishery data have quantitative assessments. These stock assessments are conducted by using a life history data to build a biologically realistic model of the fish stock, and calibrating this model so that it reproduces the observed fishery and survey data as closely as possible. During the 1990s, most West Coast groundfish assessments were conducted using the stock synthesis model. Recently there has been development of similar, but more powerful, models using state-of-the-art software tools. Assessment models and results are independently reviewed by the Council's Stock Assessment Review (STAR) panels, which are made up of scientific professionals and reviewers from the Council's groundfish advisory bodies. It is the responsibility of the STAR panels to review draft stock assessment documents and relevant information to determine if they use the available scientific data effectively to provide a good quality assessment of the condition of the stock. In addition, the STAR panels review the assessment documents to see that they are sufficiently complete and that the research needed to improve assessments in the future is identified. (Table 3.2.1) The STAR process is a key element in an overall process designed to make timely use of new fishery and survey data, to analyze and understand these data as completely as possible, to provide opportunity for public comment, and to assure that the assessment results are as accurate and error-free as possible. In 2002, the Council introduced an expedited process for species with already-reviewed assessment models and new data inputs for those models. Unlike the full STAR process, the expedited process reviews just the application of updated data series to the existing model. New types of data and new model structures are not introduced.




Following review of assessment models by the STAR panels and subsequently the Groundfish Management Team (GMT) and Scientific and Statistical Committee (SSC), the GMT uses the reviewed assessments to recommend preliminary ABCs and OYs to the Council. The SSC comments on the STAR review results and the GMT recommendations. Biomass estimates from an assessment may be for a single year or they may be the

average of the present and several future years. In general, an ABC will be calculated by applying the appropriate harvest policy (MSY proxy) to the best estimate of current biomass. ABCs based on quantitative assessments remain in effect until revised by either a full or partial assessment.

Full assessments provide information on the abundance of the stock relative to historical and target levels, and provide information on current potential yield. Partial assessments do not have enough data to provide for a full assessment. Within the range of full assessments, there is a wide range of data availability and resulting assessment certainty. Approximately four to ten full assessments are conducted each year; 26 species have been assessed (with varying degrees of completeness and precision). Several species are assessed approximately every three to four years, however some have been assessed only once, and only Pacific whiting is examined annually (both partial and full assessments are used for whiting) .

Stocks with ABCs set by non-quantitative assessments typically do not have a recent, quantitative assessment, but there may be a previous assessment or some indicators of the status of the stock. Detailed biological information is not routinely available for these stocks, and ABC levels have typically been established on the basis of average historical landings. Typically, the spawning biomass, level of recruitment, or the current fishing mortality rates are unknown.

Many species have never been assessed and lack the data necessary to conduct even a qualitative assessment (i.e., is trend up, down or stable?). ABC values have been established for only about 30 stocks. The remaining species are incidentally landed and usually are not listed separately on fish landing receipts. Information from fishery independent surveys are often lacking for these stocks, because of their low abundance or because they are not vulnerable to survey sampling gear. Precautionary measures continue to be taken when setting harvest levels (the OYs) for species that have no or only rudimentary assessments. Since implementation of the 2000 specifications, ABCs have been reduced by 25 percent to set OYs for species with less rigorous stock assessments, and by 50 percent to set OYs for those species with no stock assessment. At-sea observer data, from the West Coast groundfish observer program implemented by Amendment 13 to the FMP, is expected to be available for use in the near future to upgrade the assessment capability or evaluate their overfishing potential for these stocks. Interim ABC values may be established for these stocks based on qualitative information.

The accuracy and reliability of various data used in assessments as well as on the scientific assumptions that the assessments are based on, need to be further analyzed to improve the quality of forecasts. Further analysis of issues such as uncertainty associated with fishery logbook data, calibration of surveys, and accuracy of aging techniques are also needed. In addition, information on ecosystem change and its influence on groundfish abundance is needed. Specific stock assessment areas that have been identified as needing improvement include: develop models to better quantify uncertainty and aid communication/ implementation of precautionary approach; develop models to specifically aid in the assessment of species with limited data; improve standardization of assessment methods and conduct a formal review of these methods so that the subsequent review of each species' assessment can be shortened, which could allow more assessments to be reviewed each year; develop models to better represent spatially-structured populations, e.g., populations with low rates of internal mixing or populations with ontogenetic patterns spanning a range of habitats.

**Table 3.2.1 Research Needs Identified by Pacific Coast Groundfish Assessment Scientists**

| Species | Assemblage | Data needs identified by assessment scientists |
|---|---|---|
| **Roundfish** | | |
| Lingcod | Shelf | * Improve age structure sample size in all areas<br>*More frequent fishery independent surveys |
| Pacific Cod | Shelf | |

| Table 3.2.1 Research Needs Identified by Pacific Coast Groundfish Assessment Scientists | | |
|---|---|---|
| **Species** | **Assemblage** | **Data needs identified by assessment scientists** |
| Pacific whiting | Mid-water | * Would benefit from increased survey observations |
| Sablefish | Deep slope | * Would benefit from increased survey observations<br>* Need understanding of survey gear selectivity and catchability<br>* May benefit from ichthyoplankton surveys<br>* Would benefit from additional tagging surveys<br>* Discard data needed<br>* More biological samples from commercial catches |
| **Flatfish** | | |
| Dover sole | Deep slope | * Additional research on age and growth to reduce variability<br>* Need to examine depth strata data<br>* Discard data needed |
| English sole | Nearshore | * Need more age, maturity and length data<br>* Need recent fecundity data<br>* Additional research on aging needed<br>*More biological samples from commercial catches<br>* Shelf survey designed for rockfish, not flatfish |
| Petrale sole | Nearshore | * Genetic identity of stock<br>* More biological samples from commercial catches<br>* Need otoliths from juvenile fish take in survey catches<br>* Discard data needed<br>* Need understanding of survey gear selectivity and catchability |
| Arrowtooth flounder | Shelf, Slope | * Discard data needed<br>* Need reliable measure of abundance<br>* Shelf survey designed for rockfish, not flatfish<br>* Need to validate aging methods |
| **Rockfish** | | |
| POP | Slope | * Further age analysis<br>* Need further analysis of unfished biomass |
| Shortbelly | Shelf | * Further work on year class strength and life history needed |
| Widow | Shelf | * Need reliable measure of abundance<br>* Discard data needed<br>* Genetic identity of stock needed<br>* Need more age, maturity, and length data |
| Canary | Shelf | * Determine why there is an absence of older females in survey data<br>* Better understanding of survey gear selectivity and catchability<br>* Evaluate spawner-recruit relationships<br>* At-sea observer data needed<br>* Identify habitat and distribution<br>* Expand assessment area to include Canada<br>* Need pre-recruit surveys |
| Chilipepper | Shelf | * Would benefit from increased survey observations |
| Bocaccio | Shelf | * Review natural mortality assumptions<br>* Examine geographic relationships |
| Splitnose | Slope | * Need more age, maturity and length data<br>* Need at-sea discard data<br>* Commercial fishery landings by species needed |

| Table 3.2.1 Research Needs Identified by Pacific Coast Groundfish Assessment Scientists | | |
|---|---|---|
| **Species** | **Assemblage** | **Data needs identified by assessment scientists** |
| Yellowtail | Shelf | * Age and maturity data need to be updated<br>* Better understanding of survey gear selectivity and catchability<br>* Genetic identity of stocks needed |
| Shortspine thornyhead | Deep slope | * XXXXXXXX |
| Longspine thornyhead | Deep slope | * XXXXXXXX |
| Darkblotched | Slope | * Better commercial fishery landings by species<br>* Discard data needed<br>* Need more age, maturity and length data<br>*Genetic identity of stocks needed<br>* Better understanding of survey gear selectivity and catchability |
| Yelloweye | Shelf | * Need more age, maturity and length data<br>* Identify habitat and distribution<br>* Develop fishery independent indices<br>* Need reliable method to measure abundance |
| Cowcod | Shelf | * Need to validate aging methods<br>*Identify habitat and distribution |
| Remaining Rockfish | All | * XXXXXXXX |
| Bank | Slope (mid-water) | * Commercial fishery landings by species needed<br>* More commercial fishery age and length data<br>* Need discard data<br>* Better documentation of recreational catch<br>* Need reliable index of recruitment |
| Black | Nearshore | * XXXXXXXX |
| Blackgill | Slope | * XXXXXXXX |

**Resource Surveys** Normally a resource survey is implemented as a long-term, ongoing index to track natural and anthropogenic changes in fish abundance. In some cases, a single survey or a short time series can be directly calibrated to absolute abundance. An annual survey will most closely track natural biological fluctuations and smooth out apparent fluctuations caused by environmental effects on catchability.

For the purpose of conducting resource surveys, the groundfish species can be roughly broken into six assemblages based upon their adult habitat and co-occurrence in the fishery. *Midwater species* are semipelagic schooling species such as Pacific whiting and shortbelly rockfish. These species can be surveyed with acoustic methods. *Deep slope species* primarily includes sablefish, Dover sole, shortspine thornyhead, longspine thornyhead, and Pacific grenadier. They are found mostly on trawlable habitat on the shelf break and continental slope extending out to at least 1500 m bottom depth. Most of these species recruit on the shelf and gradually move into deeper water as they age. *Shelf species* include 30 rockfish species, lingcod, and Pacific cod. These species occur on the continental shelf. Many species are found over rocky habitat, and some species have notable off-bottom tendencies. *Slope rockfish species* includes nine rockfish species found on the upper continental slope. *Nearshore rockfish species* include13 rockfish species and a few non-rockfish species. These are mostly found in high relief habitat. *Nearshore flatfish species* include 11 flatfish species that are found on trawlable, sand-mud habitat on the continental shelf.

Long term groundfish survey efforts include: 1) *Acoustic and midwater trawl survey* - a coastwide survey that has been conducted triennially (1977-2001) for Pacific whiting, but which is now conducted biennially. Recent surveys have been coordinated with the Canadian acoustic survey to assure adequate coverage in northern areas. The survey now ranges from southern California (36°30' N. lat.) to Dixon Entrance, British Columbia (54°30' N. lat.) 2) *Shelf survey* - a bottom trawl survey conducted triennially (1977-2001) in midsummer for all fish in groundfish FMP, with sufficient coastwide coverage for most target species but did not cover south of Point Conception until 2002; survey covers the 30-275 fathoms range of bottom depths using four chartered vessels. 3) *Slope survey* - a bottom trawl survey conducted annually in mid-autumn, covers 100-700 fathom range of bottom depth coastwide, and which began in 1998 and 1999. Shelf and slope surveys will be combined for 2003. 4) *Nearshore survey* - these are SCUBA and hook-and-line surveys for various nearshore rockfish off California and are conducted by CDFG. 5) *Mark-recapture survey* for black rockfish and lingcod by WDFW. 6) *Shelf rockfish recruitment survey* - midwater trawl survey off Central California by Southwest Fisheries Science Center (SWFSC) for age 0 rockfish. 7) *Multi-species - multi-disciplinary oceanographic and egg and larvae survey* off southern California (California Cooperative Oceanographic Fisheries Investigation (CalCOFI)) which is currently conducted quarterly. NWFSC has indicated that further development of resource surveys is needed to provide an index of spawning biomass. Increasing the number of surveys and geographic scope would provide information about distribution, abundance, and age structure of many groundfish populations.

The West Coast Groundfish Research Plan identifies the following areas where further resources could be used to improve the accuracy and precision of stock assessments: development of survey methods for each of the groundfish assemblages and for each region of the coast; determine potential improvement in survey accuracy by stratifying survey effort on finer habitat features; evaluate alternative survey methodologies including egg and larval surveys, mark recapture, hook-and-line, and visual; improve tracking of natural fluctuations in Pacific whiting abundance and US-Canada distribution by increasing frequency of whiting acoustic survey (currently triennial); improving time series data, and egg and larval surveys may have useful information for some groundfish; direct calibration of surveys; direct observation of fish density using visual and laser methods; investigate catchability characteristics of sampling methods, in particular fish behavior in response to sampling gear, and environmental effects on fish-gear interactions.

**Life history and stock distribution** Biological data is necessary for accurate stock assessments and other fishery evaluations. This includes basic biological information such as stock structure, age compositions, growth, and reproduction. Currently, stock distribution and movement information for egg, larval, juvenile, and adult life stages is determined from plankton surveys, fishery resource assessment surveys, fishery logbooks, and tagging studies. Genetic characteristics and species' population structure has been investigated for a few major groundfish species using mapping, genetics, morphology, parasites, micro-constituents and other methods. "Production aging" of fishery and survey specimens for major species is done to determine patterns in recruitment and to enable age-based assessment methods. Validation of aging methods include radiometric, tag-recapture, and other techniques.

To further improve the base biological data used in assessments, scientists at the NWFSC have identified the following areas where resources are needed for improvement: age-specific growth and reproduction (maturity and fecundity) for more species; new methods to estimate natural mortality rates; genetic examination of stock structure for more species with high probabilities of having separate distinct populations; degree of mixing between and within populations; temporal and spatial trends in growth and maturation; life-history data on fish health and fitness (e.g., disease, parasite loads, bioenergetic indicators such as lipid and protein content).

**Fishery mortality** Total fishery catch data is needed so that stock assessment models can correctly separate fishing from natural causes or changes in fish abundance, and so that the effectiveness of current regulations may be determined. Data needed on an ongoing basis includes: timely estimates of total commercial and recreational catch for each gear, location and time stratum; information on bycatch, discards, and mortality of discarded bycatch; biological characteristics (age and size composition) of the

catch; standardized measurement of fishing effort and catch-per-effort; fishery-independent resource survey data; geographic distribution of catch and effort.

Currently landed commercial catch is monitored shoreside by the states and PSMFC with coastwide data access through the PacFIN data system. The basic program is based upon comprehensive mandatory commercial landings receipts to determine landed catch, and biological samples by port biologists to determine species composition of each market category and to collect size and age data. The growing nearshore commercial groundfish fisheries, including the live rockfish fishery, are monitored by state programs. Recreational fishery catch is estimated from interviews and other statistical sampling methods. There are state programs and the federal Marine Recreational Fisheries Statistics (MRFSS) program to estimate recreational catch. The catch made by or delivered to the at-sea whiting processors is monitored by observers on commercial vessels to monitor discarded catch, sample for catch composition, and collect biological data.

Trawl logbooks have been used to collect tow-by-tow data on trawl fishing effort and retained catch. Data from the three state programs are now mirrored in PacFIN. Statistical analyses to standardize fishing effort over time and between vessels have been conducted by NMFS and academic researchers. Commercial Passenger Fishing Vessels (head boats) have a logbook program in California that has been used in some stock assessments. Logbooks exist for some nontrawl commercial gears in some states, but there is no computerized database or concentrated effort at standardization or compliance.

### 3.3.2 Stock Status for Pacific Coast Groundfish Species

Each fishing year, the Council uses the best available stock assessment data to evaluate the biological condition of the Pacific Coast groundfish fishery and to develop estimates of ABCs for major groundfish stocks. The ABCs are biologically based estimates of the amount of fish that may be harvested from the fishery each year without jeopardizing the resource. The ABC may be modified to incorporate biological safety factors and risk assessment due to uncertainty.

The ABC for a species or species group is generally derived by multiplying the harvest rate proxy ($F_{MSY}$ proxy) by the exploitable biomass. When setting the 2002 ABCs, the Council maintained a policy of using a default harvest rate as a proxy for the fishing mortality rate ($F_{MSY}$ proxy) that is expected to achieve the maximum sustainable yield. Harvest rate policies must account for several complicating factors, including the age and size at which individuals in a stock reach maturity, the relative fecundity of mature individuals over time, and the optimal stock size for the highest level of productivity within that stock. Default harvest rate proxies were recommended by the Council's Scientific and Statistical Committee (SSC) in 2001 (66 FR 2338, January 11, 2001) continued to be used in 2002. These recommended harvest rate proxies are: $F_{40\%}$ for flatfish and whiting, $F_{50\%}$ for rockfish (including thornyheads,) and $F_{45\%}$ for other groundfish such as sablefish and lingcod (PFMC 2000).

Harvest levels or OYs are established each year for the species or species groups that the Council proposes to manage. Groundfish species and species groups with OYs include bocaccio, canary rockfish, chilipepper rockfish, cowcod, darkblotched rockfish, Dover sole, lingcod, longspine thornyhead, the minor rockfish complexes (northern and southern for nearshore, continental shelf, and continental slope species,) Pacific cod, Pacific ocean perch, Pacific whiting, sablefish, shortbelly rockfish, shortspine thornyhead, splitnose rockfish, widow rockfish, yelloweye rockfish, and yellowtail rockfish. Numerical OYs are not set for every stock, especially where harvest has been less than ABC.

The Magnuson-Stevens Act requires an FMP to prevent overfishing. Overfishing is defined in the National Standards Guidelines (63 FR 24212, May 1, 1998) as exceeding the fishing mortality rate needed to produce maximum sustainable yield. The OY harvest levels are set at levels that are expected to prevent overfishing, equal to or less than the ABCs. The term "overfished" describes a stock whose abundance is below its overfished/rebuilding threshold. Overfished/rebuilding thresholds are generally linked to the same productivity assumptions that determine the ABC levels. The default value of this threshold is 25%

of the estimated unfished biomass level or 50% of $B_{MSY}$, if known. Nine groundfish species are below the overfished threshold in 2002: bocaccio, canary rockfish, cowcod (south of Point Conception,) darkblotched rockfish, lingcod, Pacific whiting, Pacific ocean perch, widow rockfish, and yelloweye rockfish.

Table 3.2.1 , Summary of Stock Status for Pacific Coast Groundfish Species, summarizes the biological condition of the Pacific Coast groundfish stocks. More detailed information on the status of each of these species or species groups is available in the stock assessments associated with the annual SAFE report, as well as in the Environmental Impact Statement for Proposed Groundfish ABC and OY specifications and management measures for the 2003 Pacific Coast Groundfish Fishery. These documents are available from the Council office.

**Table 3.2.2 Summary of Stock Status for Pacific Coast Groundfish Species**

| Species | Year of Most Recent Stock Assessment | Biomass Estimate (Percent of Unfished) | Did overfishing Occur in 2001? Was the fishing mortality above the MSST[1]? | Is the stock overfished in 2001? Was the Biomass below the MSST threshold? |
|---|---|---|---|---|
| Roundfish | | | | |
| Lingcod | 2001 revision | 15% | No | Yes |
| Pacific Cod | | | Unknown | Unknown |
| Pacific whiting | 2002 | 24% | Yes | Yes |
| Sablefish | 2001 | 27%-38% | No | No |
| **Flatfish** | | | | |
| Dover sole | 2001 | 29% | No | No |
| English sole | 1993 | | Unknown | Unknown |
| Petrale sole | 1999 | 42% | Unknown | Unknown |
| Arrowtooth flounder | 1993 | | No | No |
| Other flatfish | | | Unknown | Unknown |
| **Rockfish** | | | | |
| POP | 2000 | xxx ? xxx | No | Yes |
| Shortbelly | 1989 | >43% | No | No |
| Widow | 2000 | 24% | No | Yes |
| Canary | 1999 | 22% North<br>8% South | No | Yes |
| Chilipepper | 1998 | 46%-61% | No | No |
| Bocaccio | 1999 | 2% South | No | Yes |
| Splitnose | 1994 | | Unknown | Unknown |
| Yellowtail | 2000 | 63% | No | No |
| Shortspine thornyhead | 2001 | 25%-50% | No | No |
| Longspine thornyhead | 1998 | >40% | No | No |

| Table 3.2.2 Summary of Stock Status for Pacific Coast Groundfish Species | | | | |
|---|---|---|---|---|
| Species | Year of Most Recent Stock Assessment | Biomass Estimate (Percent of Unfished) | Did overfishing Occur in 2001? Was the fishing mortality above the MSST[1]? | Is the stock overfished in 2001? Was the Biomass below the MSST threshold? |
| Darkblotched | 2000 | 12% | No | Yes |
| Yelloweye | 2001 | 7% | No | Yes |
| Cowcod | 1999 | 4%-11% | No | Yes |
| Bank | xxx ? xxx | | No | No |
| Black | 1999 & 2001[2] | 35%[2] | No | No |
| Blackgill | 1998 | 51% | Unknown | Unknown |
| Redstripe | | | Unknown | Unknown |
| Sharpchin | | | Unknown | Unknown |
| Silvergrey | | | No | Unknown |
| Yellowmouth | | | Unknown | Unknown |
| Other rockfish | | | Unknown | Unknown |
| **Other fish** | | | Unknown | Unknown |

1) MSST – The minimum stock size threshold (overfished/rebuilding threshold) is the default value of 25% of the estimated unfished biomass level or 50% of $B_{MSY}$, if known.
2) 2001 update completed for Oregon only.

### 3.2.3 Groundfish Resources

The Pacific Coast groundfish FMP manages over 80 species which are divided by type as follows: roundfish, flatfish, rockfish, sharks, skates, ratfish, morids, and grenadiers. These species, occur throughout the EEZ and occupy diverse habitats at all stages in their life history. Information on the interactions between the various groundfish species and between groundfish and non-groundfish species varies in completeness. While a few species have been intensely studied, there is relatively little information on most groundfish species

**Roundfish**

*Lingcod* (*Ophiodon elongatus*), a top order predator of the family Hexagrammidae, ranges from Baja California to Kodiak Island in the Gulf of Alaska. Lingcod is demersal at all life stages (Allen & Smith 1988, NOAA 1990, Shaw & Hassler 1989). Adult lingcod prefer two main habitat types: slopes of submerged banks 10-70 m below the surface with seaweed, kelp and eelgrass beds and channels with swift currents that flow around rocky reefs (Emmett et al. 1991, Giorgi & Congleton 1984, NOAA 1990, Shaw & Hassler 1989). Juveniles prefer sandy substrates in estuaries and shallow subtidal zones (Emmett et al. 1991, Forrester 1969, Hart 1973, NOAA 1990, Shaw & Hassler 1989). As the juveniles grow they move to deeper waters. Adult lingcod are considered a relatively sedentary species, but there are reports of migrations of greater than 100 km by sexually immature fish (Jagielo 1990, Mathews & LaRiviere 1987, Mathews 1992, Smith et al. 1990).

Mature females live in deeper water than males and move from deep water to shallow water in the winter to spawn (Forrester 1969, Hart 1973, Jagielo 1990, LaRiviere et al. 1980, Mathews & LaRiviere 1987, Mathews 1992, Smith et al. 1990). Mature males may live their whole lives associated with a single rock reef, possibly out of fidelity to a prime spawning or feeding area (Allen & Smith 1988, Pikitch 1989, Shaw & Hassler 1989). Spawning generally occurs over rocky reefs in areas of swift current (Adams 1986,

Adams & Hardwick 1992, Giorgi 1981, Giorgi & Congleton 1984, LaRiviere et al. 1980). After the females leave the spawning grounds, the males remain in nearshore areas to guard the nests until the eggs hatch. Hatching occurs in April off Washington but as early as January and as late as June at the geographic extremes of the lingcod range. Males begin maturing at about 2 years (50 cm), whereas females mature at 3+ years (76 cm). In the northern extent of their range, fish mature at an older age and larger size (Emmett et al. 1991, Hart 1973, Mathews & LaRiviere 1987, Miller & Geibel 1973, Shaw & Hassler 1989). The maximum age for lingcod is about 20 years (Adams & Hardwick 1992).

Lingcod are a visual predator, feeding primarily by day. Larvae are zooplanktivores (NOAA 1990). Small demersal juveniles prey upon copepods, shrimps and other small crustaceans. Larger juveniles shift to clupeids and other small fishes (Emmett et al. 1991, NOAA 1990). Adults feed primarily on demersal fishes (including smaller lingcod), squids, octopi and crabs (Hart 1973, Miller & Geibel 1973, Shaw & Hassler 1989). Lingcod eggs are eaten by gastropods, crabs, echinoderms, spiny dogfish, and cabezon. Juveniles and adults are eaten by marine mammals, sharks, and larger lingcod (Miller & Geibel 1973, NOAA 1990)

*Pacific Cod* (*Gadus macrocephalus*) are widely distributed in the coastal north Pacific, from the Bering Sea to southern California in the east, and to the Sea of Japan in the west. Adult Pacific cod occur as deep as 875 m (Allen & Smith 1988), but the vast majority occurs between 50 and 300 m (Allen & Smith 1988, Hart 1973, Love 1991, NOAA 1990). Along the West Coast, Pacific cod prefer shallow, soft-bottom habitats in marine and estuarine environments (Garrison & Miller 1982), although adults have been found associated with coarse sand and gravel substrates (Palsson 1990, Garrison & Miller 1982). Larvae and small juveniles are pelagic; large juveniles and adults are parademersal (Dunn & Matarese 1987, NOAA 1990). Adult Pacific cod are not considered to be a migratory species. There is however a seasonal bathymetric movement from deep spawning areas of the outer shelf and upper slope in fall and winter to shallow middle-upper shelf feeding grounds in the spring (Dunn & Matarese 1987, Hart 1973, NOAA 1990, Shimada & Kimura 1994).

Pacific cod have external fertilization (Hart 1973, NOAA 1990) and spawning from late fall to early spring. Their eggs are demersal. Larvae may be transported to nursery areas by tidal currents (Garrison & Miller 1982). Half of females are mature by 3 years ( 55 cm), and half of males are mature by 2 years (45 cm) (Dunn & Matarese 1987, Hart 1973). Juveniles and adults are carnivorous, and feed at night (Allen & Smith 1988, Palsson 1990) with the main part of the adult Pacific cod diet being whatever prey species is most abundant (Kihara & Shimada 1988,Klovach et al. 1995). Larval feeding is poorly understood. Pelagic fish and sea birds eat Pacific cod larvae, while juveniles are eaten by larger demersal fishes, including Pacific cod. Adults are preyed upon by toothed whales, Pacific halibut, salmon shark, and larger Pacific cod (Hart 1973, Love 1991, NOAA 1990, Palsson 1990). The closest competitor of the Pacific cod for resources is the sablefish (Allen 1982).

*Pacific Whiting* (*Merluccius productus*), also known as Pacific hake, is a semi-pelagic merlucciid (a cod-like fish species) that range from Sanak Island in the western Gulf of Alaska to Magdalena Bay, Baja California Sur. They are most abundant in the California Current System (Bailey 1982, Hart 1973, Love 1991, NOAA 1990). Smaller populations of Pacific whiting occur in several of the larger semi-enclosed inlets of the northeast Pacific Ocean, including the Strait of Georgia, Puget Sound, and the Gulf of California (Bailey et al. 1982, Stauffer 1985). The highest densities of Pacific hake are usually between 50 and 500 m, but adults occur as deep as 920 m and as far offshore as 400 km (Bailey 1982, Bailey et al. 1982, Dark & Wilkins 1994, Dorn 1995, Hart 1973, NOAA 1990, Stauffer 1985). Hake school at depth during the day, then move to the surface and disband at night for feeding (McFarlane & Beamish 1986, Sumida & Moser 1984, Tanasich et al. 1991). Coastal stocks spawn off Baja California in the winter, then the mature adults begin moving northward and inshore, following food supply and Davidson currents (NOAA 1990). Hake reach as far north as southern British Columbia by fall. They then begin the southern migration to spawning grounds and further offshore (Bailey et al. 1982, Dorn 1995, Smith 1995, Stauffer 1985).

Spawning occurs from December through March, peaking in late January (Smith 1995). Pacific hake are oviparous with external fertilization. Eggs of the Pacific hake are neritic and float to neutral buoyancy (Baily 1981, Bailey et al. 1982, NOAA 1990). Hatching occurs in 5-6 days and within 3-4 months juveniles are typically 35 mm (Hollowed 1992). Juveniles move to deeper water as they get older (NOAA 1990). Females off mature at 3-4 years (34-40 cm,) and nearly all males are mature by 3 years (28 cm). Females grow more rapidly than males after four years; growth ceases for both sexes at 10-13 years (Bailey et al. 1982).

All life stages feed near the surface late at night and early in the morning (Sumida & Moser 1984). Larvae eat calanoid copepods, as well as their eggs and nauplii (McFarlane & Beamish 1986, Sumida & Moser 1984). Juveniles and small adults feed chiefly on euphausiids (NOAA 1990). Large adults also eat amphipods, squid, herring, smelt, crabs, and sometimes juvenile hake (Bailey 1982, Dark & Wilkins 1994, McFarlane & Beamish 1986, NOAA 1990). Eggs and larvae of Pacific hake are eaten by pollock, herring, invertebrates, and sometimes hake. Juveniles are eaten by lingcod, Pacific cod and rockfish species. Adults are preyed on by sablefish, albacore, pollock, Pacific cod, marine mammals, soupfin sharks and spiny dogfish (Fiscus 1979, McFarlane & Beamish 1986, NOAA 1990).

*Sablefish* (*Anoplopoma fimbria*) are abundant in the north Pacific, from Honshu Island, Japan, north to the Bering Sea, and southeast to Cedros Island, Baja California. There are at least three genetically distinct populations off the West Coast of North America: one south of Monterey characterized by slower growth rates and smaller average size, one that ranges from Monterey to the U.S./Canada border that is characterized by moderate growth rates and size, and one ranging off British Columbia and Alaska characterized by fast growth rates and large size. Large adults are uncommon south of Point Conception (Hart 1973, Love 1991, McFarlane & Beamish 1983a, McFarlane & Beamish 1983b, NOAA 1990). Adults are found as deep as 1,900 m, but are most abundant between 200 and 1,000 m (Beamish & McFarlane 1988, Kendall & Matarese 1987, Mason et al. 1983). Off southern California, sablefish were abundant to depths of 1500 m (MBC 1987). Adults and large juveniles commonly occur over sand and mud (McFarlane & Beamish 1983a, NOAA 1990) in deep marine waters. They were also reported on hard-packed mud and clay bottoms in the vicinity of submarine canyons (MBC 1987).

Spawning occurs annually in the late fall through winter in waters greater than 300 m (Hart 1973, NOAA 1990). Sablefish are oviparous with external fertilization (NOAA 1990). Eggs hatch in about 15 days (Mason et al. 1983, NOAA 1990) and are demersal until the yolk sac is absorbed (Mason et al. 1983). After yolk sac is absorbed, the age-0 juveniles become pelagic. Older juveniles and adults are benthopelagic. Larvae and small juveniles move inshore after spawning and may rear for up to four years (Boehlert & Yoklavich 1985, Mason et al. 1983). Older juveniles and adults inhabit progressively deeper waters. The best estimates indicate that 50% of females are mature at 5-6 years (24 inches), and 50% of males are mature at 5 years (20 inches).

Sablefish larvae prey on copepods and copepod nauplii. Pelagic juveniles feed on small fishes and cephalopods, mainly squids (Hart 1973, Mason et al. 1983). Demersal juveniles eat small demersal fishes, amphipods and krill (NOAA 1990). Adult sablefish feed on fishes like rockfishes and octopus (Hart 1973, McFarlane & Beamish 1983a). Larvae and pelagic juvenile sablefish are heavily preyed upon by sea birds and pelagic fishes. Juveniles are eaten by Pacific cod, Pacific halibut, lingcod, spiny dogfish, and marine mammals, such as Orca whales (Cailliet et al. 1988, Hart 1973, Love 1991, Mason et al. 1983, NOAA 1990). Sablefish compete with many other co-occurring species for food, mainly Pacific cod and spiny dogfish (Allen 1982).

## Flatfish

*Dover Sole* (*Microstomus pacificus*) are distributed from the Navarin Canyon in the northwest Bering Sea and westernmost Aleutian Islands to San Cristobal Bay, Baja California (Hagerman 1952, Hart 1973, NOAA 1990). Dover sole are a dominant flatfish on the continental shelf and slope from Washington to

southern California. Adults are demersal and are found from 9-1,450 m, with highest abundance below 200-300 m (Allen & Smith 1988). Adults and juveniles, show a high affinity toward soft bottoms of fine sand and mud. Juveniles are often found in deep nearshore waters. Dover sole are considered to be a migratory species. In the summer and fall, mature adults and juveniles can be found in shallow feeding grounds, as shallow as 55 m off British Columbia (Westrheim & Morgan 1963). By late fall, the Dover sole begin moving offshore into deep waters (400 m or more) to spawn. Although there is an inshore-offshore seasonal migration, little north-south coastal migration occurs (Westrheim & Morgan 1963)

Spawning occurs from November-April off Oregon and California (Hart 1973, NOAA 1990, Pearcy et al. 1977) in waters 80-550 m depth at or near the bottom (Hagerman 1952, Hart 1973, Pearcy et al. 1977). Dover sole are oviparous; fertilization is external. Larvae are planktonic, being transported offshore and to nursery areas by ocean currents and winds for up to two years. Settlement to benthic living occurs mid-autumn to early spring off Oregon, and February-July off California (Markle et al 1992). Juvenile fish move into deeper water with age, and begin seasonal spawning-feeding migrations upon reaching maturity.

Dover sole larvae eat copepods, eggs and nauplii, as well as other plankton. Juveniles and adults eat polychaetes, bivalves, brittlestars and small benthic crustaceans. Dover sole feed diurnally by sight and smell (Dark & Wilkins 1994, Gabriel & Pearcy 1981, Hart 1973, NOAA 1990). Dover sole larvae are eaten by pelagic fishes like albacore, jack mackerel and tuna, as well as sea birds. Juveniles and adults are preyed upon by sharks, demersally feeding marine mammals, and to some extent by sablefish (NOAA 1990). Dover sole compete with various eelpout species, rex sole, English sole, and other fishes of the mixed species flatfish assemblage (NOAA 1990).

*English Sole* (*Parophrys vetulus*) are found from Nunivak Island in the southeast Bering Sea and Agattu Island in the Aleutian Islands, to San Cristobal Bay, Baja California Sur (Allen & Smith 1988). In research survey data, nearly all occurred at depths <250 m (Allen & Smith 1988). Adults and juveniles prefer soft bottoms composed of fine sands and mud (Ketchen 1956), but also occur in eelgrass habitats (Pearson & Owen 1992). English sole uses nearshore coastal and estuarine waters as nursery areas (Krygier & Pearcy 1986, Rogers et al. 1988**)**. Adults make limited migrations. Those off Washington show a northward post-spawning migration in the spring on their way to summer feeding grounds, and a southerly movement in the fall (Garrison & Miller 1982). Tagging studies have identified separate stocks based on this species' limited movements and meristic characteristics (Jow 1969).

Spawning occurs over soft-bottom mud substrates (Ketchen 1956) from winter to early spring depending on the stock. Eggs are neritic and buoyant, but sink just before hatching (Hart 1973), juveniles and adults are demersal (Garrison & Miller 1982). Small juveniles settle in the estuarine and shallow nearshore areas all along the coast, but are less common in southerly areas, particularly south of Point Conception. Large juveniles commonly occur up to depths of 150 m. Although many postlarvae may settle outside of estuaries, most will enter estuaries during some part of their first year of life (Gunderson et al. 1990). Some females mature as 3-year-olds (26 cm), but all females over 35 cm long are mature. Males mature at 2 years ( 21 cm).

Larvae are planktivorous. Juveniles and adults are carnivorous, eating copepods, amphipods, cumaceans, mysids, polychaetes, small bivalves, clam siphons, and other benthic invertebrates (Allen 1982, Becker 1984, Hogue & Carey 1982, Simenstad et al. 1079) . English sole feed primarily by day, using sight and smell, and sometimes dig for prey (Allen 1982, Hulberg & Oliver 1979). A juvenile English sole's main predators are probably piscivorous birds such as great blue heron (Ardia herodias), larger fishes and marine mammals. Adults may be eaten by marine mammals, sharks, and other large fishes.

*Petrale Sole* (*Eopsetta jordani*) are found form Cape St. Elias, Alaska to Coronado Island, Baja California. The range may possibly extend into the Bering Sea, but the species is rare north and west of southeast Alaska and in the inside waters of British Columbia (Garrison & Miller 1982, Hart 1973). Nine separate breeding stocks have been identified, although stocks intermingle on summer feeding grounds (Hart

1973, NOAA 1990). Of these nine, one occurs off British Columbia, two off Washington, two off Oregon and four off California (NOAA 1990). Adults are found from the surf line to 550 m, but their highest abundance is <300 m (NOAA 1990). Adults migrate seasonally between deepwater, winter spawning areas to shallower, spring feeding grounds (NOAA 1990). They show an affinity to sand, sandy mud and occasionally muddy substrates (NOAA 1990).

Spawning occurs over the continental shelf and continental slope to as deep as 550 m. Eggs are pelagic and juveniles and adults are demersal (Garrison & Miller 1982). Eggs and larvae are transported from offshore spawning areas to nearshore nursery areas by oceanic currents and wind. Larvae metamorphose into juveniles at six months (22 cm) and settle to the bottom of the inner continental shelf (Pearcy et al. 1977). Petrale sole tend to move into deeper water with increased age and size. Petrale sole begin maturing at three years. Half of males mature by seven years (29-43 cm) and half of the females are mature by eight years (>44 cm) (Pedersen 1975a, Pedersen 1975b ). Near the Columbia River, petrale sole mature one to two years earlier (Pedersen 1975a, Pedersen 1975b).

Larvae are planktivorous. Small juveniles eat mysids, sculpins and other juvenile flatfishes. Large juveniles and adults eat shrimps and other decapod crustaceans, as well as euphausiids, pelagic fishes, ophiuroids and juvenile petrale sole (Garrison & Miller 1982, Hart 1973, 162, NOAA 1990, Pearcy et al. 1977, Pedersen 1975a, Pedersen 1975b). Petrale sole eggs and larvae are eaten by planktivorous invertebrates and pelagic fishes. Juveniles are preyed upon (sometimes heavily) by adult petrale sole, as well as other large flatfishes. Adults are preyed upon by sharks, demersally feeding marine mammals, and larger flatfishes and pelagic fishes (NOAA 1990). Petrale sole competes with other large flatfishes. It has the same summer feeding grounds as lingcod, English sole, rex sole and Dover sole (NOAA 1990).

*Arrowtooth Flounder* (*Atheresthes stomias*) range from the southern coast of Kamchatka to the northwest Bering Sea and Aleutian Islands to San Simeon, California. Arrowtooth flounder is the dominant flounder species on the outer continental shelf from the western Gulf of Alaska to Oregon. Eggs and larvae are pelagic; juveniles and adults are demersal (Garrison & Miller 1982, NOAA 1990). Juveniles and adults are most commonly found on sand or sandy gravel substrates, but occasionally occur over low-relief rock-sponge bottoms Arrowtooth flounder exhibit a strong migration from shallow water summer feeding grounds on the continental shelf to deep water spawning grounds over the continental slope (NOAA 1990). Depth distribution may vary from as little as 50 m in summer to more than 500 m in the winter (NOAA 1990, Rickey 1995).

Arrowtooth flounder are oviparous with external fertilization (Barry 1996). Spawning may occur deeper than 500 m off Washington (Rickey 1995). Larvae eat copepods, their eggs and copepod nauplii (Yang 1995, Yang & Livingston 1985). Juveniles and adults feed on crustaceans (mainly ocean pink shrimp and krill) and fish (mainly gadids, herring and pollock) (Hart 1973, NOAA 1990). Arrowtooth flounder exhibit two feeding peaks, at noon and midnight

*"Other Flatfish"* are those species that do not have individual ABC/OYs and include butter sole, curlfin sole, flathead sole, Pacific sand dab, rex sole, rock sole, sand sole, and starry flounder. Life history descriptions of these species may be found in the Essential Fish Habitat West Coast Groundfish which was prepared for Amendment 11 to the FMP. This document may be requested from the Council office or is available online at http://www.nwr.noaa.gov/1sustfsh/efhappendix/page1.html

**Rockfish**

*Pacific ocean perch* (*Sebastes alutus*) are found from La Jolla (southern California) to the western boundary of the Aleutian Archipelago (Eschmeyer et al 1983, Gunderson 1971, to 1986, Miller & Lea 1972), but are common from Oregon northward (Eschmeyer et al 1983). Pacific ocean perch primarily inhabit waters of the upper continental slope (Dark & Wilkins 1994) and are found along the edge of the continental shelf (Archibald et al. 1983). Pacific ocean perch occur as deep as 825 m, but usually are at 100-450 m and along submarine canyons and depressions (NOAA 1990). Larvae and juveniles are

pelagic; subadults and adults are benthopelagic. Adults form large schools 30 m wide, to 80 m deep, and as much as 1,300 m long (NOAA 1990). They also form spawning schools (Gunderson 1971). Juvenile Pacific ocean perch form ball-shaped schools near the surface or hide in rocks (NOAA 1990). Throughout its range, Pacific ocean perch is generally associated with gravel, rocky or boulder type substrate found in and along gullies, canyons, and submarine depressions of the upper continental slope (Ito 1986).

Pacific ocean perch winter and spawn in deeper water (>275 m), then move to feeding grounds in shallower water (180-220 m) in the summer (June-August) to allow gonads to ripen (Archibald et al. 1983, Gunderson 1971, NOAA 1990). Pacific ocean perch are slow-growing and long-lived. The maximum age has been estimated at about 90 years (ODFW, personal communication). Largest size is about 54 cm and 2 kg (Archibald et al. 1983, Beamish 1979, Eschmeyer et al. 1983, Ito 1986, Mulligan & Leaman 1992, NOAA 1990, Richards 1994). Pacific ocean perch are carnivorous. Larvae eat small zooplankton. Small juveniles eat copepods, and larger juveniles feed on euphausiids. Adults eat euphausiids, shrimps, squids, and small fishes. Immature fish feed throughout the year, but adults feed only seasonally, mostly April-August (NOAA 1990). Predators of Pacific ocean perch include sablefish and Pacific halibut.

*Shortbelly rockfish* (*Sebastes jordani*) are found from San Benito Islands, Baja California, Mexico to La Perouse Bank, British Columbia (Eschmeyer et al 1983, Lenarz 1980). The habitat of the shortbelly rockfish is wide ranging (Eschmeyer et al 1983). Shortbelly rockfish inhabit waters from 50-350 m in depth (Allen & Smith 1988) on the continental shelf (Chess et al. 1988) and upper-slope (Stull & Tang 1996). Adults commonly form very large schools over smooth bottom near the shelf break (Lenarz 1992). Shortbelly rockfish have also been observed along the Monterey Canyon ledge (Sullivan 1995). During the day shortbelly rockfish are found near the bottom in dense aggregations. At night they are more dispersed. (Chess et al 1988). During the summer shortbelly rockfish tend to move into deeper waters and to the north as they grow, but they do not make long return migrations to the south in the winter to spawn (Lenarz 1980).

Shortbelly rockfish are viviparous, bearing advanced yolk-sac larvae (Ralston et al 1996). Shortbelly rockfish spawn off California during January through April (Lenarz 1992). Larvae metamorphose to juveniles at 27 mm and appear to begin forming schools at the surface at that time (Laidig et al. 1991, Lenarz 1980). A few shortbelly rockfish mature at age 2, while 50% are mature at age 3 and nearly all are mature by age 4 (Lenarz 1992). They live to be about 10 years old (Lenarz 1980, MacGregor 1986) with the maximum recorded age being 22 years (Lenarz 1992).

Shortbelly rockfish feed primarily on various life stages of euphausiids and calanoid copepods both during the day and night (Chess et al. 1988, Lenarz et al. 1991). Shortbelly rockfish play a key role in the food chain, as they are preyed upon by chinook and coho salmon, lingcod, black rockfish, hake, bocaccio, chilipepper, pigeon guillemots, western gull, marine mammals, and others (Chess et al. 1988, Eschmeyer et al. 1983, Hobson & Howard 1989, Lenarz 1980).

*Widow rockfish* (*Sebastes entomelas*) range from Albatross Bank of Kodiak Island to Todos Santos Bay, Baja California (Eschmeyer et al. 1983, Laroche & Richardson 1981, Miller & Lea 1972, NOAA 1990). Widow rockfish occur over hard bottoms along the continental shelf (NOAA 1990) Widow rockfish prefer rocky banks, seamounts, ridges near canyons, headlands, and muddy bottoms near rocks. Large widow rockfish concentrations occur off headlands such as Cape Blanco, Cape Mendocino, Pt. Reyes, and Pt. Sur. Adults form dense, irregular, midwater and semi-demersal schools deeper than 100 m at night and disperse during the day (Eschmeyer et al. 1983, NOAA 1990, Wilkins 1986). All life stages are pelagic, but older juveniles and adults are often associated with the bottom (NOAA 1990). All life stages are fairly common from Washington to California (NOAA 1990). Pelagic larvae and juveniles co-occur with yellowtail rockfish, chilipepper, shortbelly rockfish, and bocaccio larvae and juveniles off central California (Reilly et al 1992).

Widow rockfish are viviparous, have internal fertilization, and brood their eggs until released as larvae (NOAA 1990, Ralston et al 1996, Reilly et al 1992). Mating occurs from late fall-early winter. Larval

release occurs from December-February off California, and from February-March off Oregon. Juveniles are 21-31 mm at metamorphosis, and they grow to 25-26 cm over 3 years. Age and size at sexual maturity varies by region and sex, generally increasing northward and at older ages and larger sizes for females. Some mature in 3 years (25-26 cm), 50% are mature by 4-5 years (25-35 cm), and most are mature in 8 years (39-40 cm) (Barss & Wyllie-Echeverria 1987, NOAA 1990). The maximum age of widow rockfish is 28 years, but rarely over 20 years for females and 15 years for males (NOAA 1990). The largest size is 53 cm, about 2.1 kg (Eschmeyer et al. 1983, NOAA 1990).

Widow rockfish are carnivorous. Adults feed on small pelagic crustaceans, midwater fishes (such as age-1 or younger Pacific hake), salps, caridean shrimp, and small squids (Adams 1987, NOAA 1990). During spring, the most important prey item is salps, during the fall fish are more important, and during the winter widow rockfish primarily eat sergestid shrimp (Adams 1987). Feeding is most intense in the spring after spawning (NOAA 1990). Pelagic juveniles are opportunistic feeders and their prey consists of various life stages of calanoid copepods, and euphausiids (Reilly et al. 1992).

*Canary Rockfish* (*Sebastes pinniger*) are found between Cape Colnett, Baja California, and southeastern Alaska (Boehlert 1980, Boehlert & Kappenman 1980, Hart 1973, Love 1991,Miller & Lea 1972, Richardson & Laroche 1979). There is a major population concentration of canary rockfish off Oregon (Richardson & Laroche 1979). Canary primarily inhabit waters 91-183 m deep (Boehlert & Kappenman 1980). In general, canary rockfish inhabit shallow water when they are young and deep water as adults (Mason 1995). Adult canary rockfish are associated with pinnacles and sharp drop-offs (Love 1991). Canary rockfish are most abundant above hard bottoms (Boehlert & Kappenman 1980). In the southern part of its range, the canary rockfish appears to be a reef-associated species (Boehlert 1980). In central California, newly settled canary rockfish are first observed seaward of the sand-rock interface and farther seaward in deeper water (18-24 m).

Canary rockfish are ovoviviparous and have internal fertilization (Boehlert & Kappenman 1980, Richardson & Laroche 1979). Off California, canary rockfish spawn from November-March and from January-March off Oregon and, Washington, (Hart 1973, Love 1991, Richardson & Laroche 1979). The age of 50% maturity of canary rockfish is 9 years; nearly all are mature by age 13 . The maximum length canary rockfish grow to is 76 cm (Boehlert & Kappenman 1980, Hart 1973, Love 1991). Canary rockfish primarily prey on planktonic creatures, such as krill, and occasionally on fish (Love 1991). Canary rockfish feeding increases during the spring-summer upwelling period when euphausiids are the dominant prey and the frequency of empty stomachs is lower (Boehlert et al. 1989).

*Chilipepper rockfish* (*Sebastes goodei*) are found from Magdalena Bay, Baja California, to as far north as the northwest coast of Vancouver Island, British Columbia (Allen & Smith 1988, Hart 1973, Miller & Lea 1972). Chilipepper have been taken as deep as 425 m, but nearly all in survey catches were taken between 50 and 350 m (Allen & Smith 1988). Adults and older juveniles usually occur over the shelf and slope; larvae and small juveniles are generally found near the surface. In California, chilipepper are most commonly found associated with deep, high relief rocky areas and along cliff drop-offs (Love et al. 1990), as well as on sand and mud bottoms (MBC 1987). They are occasionally found over flat, hard substrates (Love et al. 1990). Love (1981) does not consider this to be a migratory species. Chilipepper may migrate as far as 45 m off the bottom during the day to feed (Love 1981).

Chilipeppers are ovoviviparous, and eggs are fertilized internally (Reilly et al. 1992). Chilipepper school by sex just prior to spawning (MBC 1987). In California, fertilization of eggs begins in October ands spawning occurs from September to April (Oda 1992) with the peak being December to January (Love et al. 1990). Chilipepper may spawn multiple broods in a single season (Love et al. 1990). Females of the species are notably larger, reaching lengths of up to 56 cm (Hart 1973). Males are usually smaller than 40 cm (Dark & Wilkins 1994). Males mature at 2 to 6 years of age and 50% are mature at 3 to 4 years. Females mature at 2 to 5 years with 50% mature at 3 to 4 years (MBC 1987). Females may attain an age of about 27 years whereas the maximum age for males is about 12 years (MBC 1987).

Larval and juvenile chilipepper eat all life stages of copepods and euphausiids, and are considered to be somewhat opportunistic feeders (Reilly et al. 1992). In California, adults prey on large euphausiids, squid, and small fishes such as anchovies, lanternfish and young hake (Hart 1973, Love et al. 1990). Chilipepper are found with widow rockfish, greenspotted rockfish, and swordspine rockfish (Love et al. 1990). Juvenile chilipepper compete for food with bocaccio, yellowtail rockfish, and shortbelly rockfish (Reilly et al. 1992).

*Bocaccio rockfish* (*Sebastes paucispinis*) are found in the Gulf of Alaska off Krozoff and Kodiak Islands, south as far as Sacramento Reef, Baja California (Hart 1973, Miller & Lea 1972). In survey catches, Allen and Smith (1988) found bocaccio to be most common at 100-150 m over the outer continental shelf. Sakuma and Ralston (1995) categorized bocaccio as both a nearshore and offshore species. Larvae and small juveniles are pelagic (Garrison & Miller 1982) and are commonly found in the upper 100 m of the water column, often far from shore (MBC 1987). Large juveniles and adults are semi-demersal and are most often found in shallow coastal waters over rocky bottoms associated with algae (Sakuma & Ralston). Adults are commonly found in eelgrass beds, or congregated around floating kelp beds (Love et al. 1990, Sakuma & Ralston). Young and adult bocaccio also occur around artificial structures, such as piers and oil platforms (MBC 1987). Although juveniles and adults are usually found around vertical relief, adult aggregations also occur over firm sand-mud bottoms (MBC 1987). Bocaccio move into shallow waters during their first year of life (Hart 1973), then move into deeper water with increased size and age (Garrison & Miller 1982).

Bocaccio are ovoviviparous (Garrison & Miller 1982, Hart 1973). Love et al. (1990) reported the spawning season to be protracted and to last almost year-round (>10 months). Parturition occurs during January to April off Washington, November to March off northern and central California, and October to March off southern California (MBC 1987). Two or more broods may be born in a year in California (Love et al. 1990). The spawning season is not well known in northern waters. Males mature at 3 to 7 years with 50% mature in 4 to 5 years. Females mature at 3 to 8 years with 50% mature in 4 to 6 years (MBC 1987).

Larval bocaccio often eat diatoms, dinoflagellates, tintinnids, and cladocerans (Sumida & Moser 1984). Copepods and euphausiids of all life stages (adults, nauplii and egg masses) are common prey for juveniles (Sumida & Moser 1984). Adults eat small fishes associated with kelp beds, including other species of rockfishes, and occasionally small amounts of shellfish (Sumida & Moser 1984). Bocaccio are eaten by sharks, salmon, other rockfishes, lingcod and albacore, as well as sea lions, porpoises, and whales (MBC 1987). Bocaccio directly compete with chilipepper and widow, yellowtail, and shortbelly rockfishes for both food and habitat resources (Reilly et al. 1992).

*Splitnose rockfish* (*Sebastes diploproa*) occur from Prince William Sound, Alaska to San Martin Island, Baja California (Miller & Lea 1972). Splitnose rockfish occur from 0-800 m, with most of survey catches occurring in depths of 100-450 m (Allen & Smith 1988). The relative abundance of juveniles (<21 cm) is quite high in the 91-272 m depth zone and then decreases sharply in the 274-475 m depth zone (Boehlert 1980). Splitnose rockfish have a pelagic larval stage and prejuvenile stage, and a benthic juvenile stage (Boehlert 1977). Benthic splitnose rockfish associate with mud habitats (Boehlert 1980). Young occur in shallow water, often at the surface under drifting kelp (Eschmeyer et al. 1983). The major types of vegetation that juveniles are found under are Fucus sp. (dominant), eelgrass, and bull kelp (Schaffer et al 1995). Juvenile splitnose rockfish off southern California are the dominant rockfish species found under drifting kelp (Boehlert 1977).

Splitnose are ovoviviparous and release yolk sac larvae (Boehlert 1977). They may have two parturition seasons, or may possibly release larvae throughout the year (Boehlert 1977). In general, the main parturition season get progressively shorter and later toward the north (Boehlert 1977). Splitnose rockfish growth rates vary with latitude, being generally faster in the north. Splitnose mean sizes increase with depth in a given latitudinal area. Mean lengths of females are generally greater than males (Boehlert 1980). Off California, 50% maturity occurs at 21 cm, or 5 years of age, whereas off British Columbia 50% of males and females are mature at 27 cm (Hart 1973). Adults can achieve a maximum size of 46 cm

(Boehlert 1980, Eschmeyer et al. 1983, Hart 1973). As estimated from otolith readings, females have surface ages to 55 years and section ages to 81 years.

Adult splitnose rockfish off southern California feed on midwater plankton, primarily euphausiids (Allen 1982). Juveniles feed mainly on planktonic organisms, including copepods and cladocerans during June and August. In October, their diets shift to larger epiphytic prey and are dominated by a single amphipod species. Juvenile splitnose rockfish actively select prey (Schaffer et al. 1995) and are probably diurnally active (Allen 1982). Adults are probably nocturnally active, at least in part (Allen 1982).

*Yellowtail rockfish* (*Sebastes flavidus*) range from San Diego, California, to Kodiak Island, Alaska (Fraidenburg 1980, Gotshall 1981, Lorz et al. 1983, Love 1991, Miller & Lea 1972, Norton & MacFarlane 1995). The center of yellowtail rockfish abundance is from Oregon to British Columbia (Fraidenburg 1980). Yellowtail rockfish are a common, demersal species abundant over the middle shelf (Carlson 1972, Fraidenburg 1980, Tagert 1991, Weinberg 1994). Yellowtail rockfish are most common near the bottom, but not on the bottom (Love 1991, Stanley et al. 1994). Yellowtail adults are considered semi-pelagic (Stanely et al. 1994, Stein et al. 1992) or pelagic which allows them to range over wider areas than benthic rockfish (Pearcy 1992). Adult yellowtail rockfish occur along steeply sloping shores or above rocky reefs (Hart 1973). They can be found above mud with cobble, boulder and rock ridges, and sand habitats; they are not, however, found on mud, mud with boulder, or flat rock (Love 1991, Stein et al. 1992). Yellowtail rockfish form large (sometimes greater than 1,000 fish) schools and can be found alone or in association with other rockfishes (Love 1991, Pearcy 1992, Rosenthal et al. 1982, Stein et al. 1992, Tagert 1991). These schools may persist at the same location for many years (Pearcy 1992).

Yellowtail rockfish are viviparous (Norton & MacFarlane 1995) and mate from October to December. Parturition peaks in February and March and from November-March off California (Westrheim 1975). Young-of-the-year pelagic juveniles often appear in kelp beds beginning in April and live in and around kelp, in midwater during the day, descending to the bottom at night (Love 1991, Tagert 1991). Male yellowtail rockfish are 34-41 cm in length (5-9 years) at 50% maturity, females are 37-45 cm (6-10 years) (Tagert 1991). Yellowtail rockfish are long-lived and slow-growing; the oldest recorded was 64 years old (Fraidenburg 1981, Tagert 1991). Even though they are slow growing, like other rockfish, they have a high growth rate when compared to other rockfish (Tagert 1991). They reach a maximum size of about 55 cm in approximately 15 years (Tagert 1991). Yellowtail rockfish feed mainly on pelagic animals, but are opportunistic, occasionally eating benthic animals as well (Lorz et al. 1983). Large juveniles and adults eat fish (small hake, Pacific herring, smelt, anchovies, lanternfishes, and others), along with squid, krill, and other planktonic organisms (euphausiids, salps, and pyrosomes) (Love 1991, Phillips 1964, Rosenthal et al. 1982, Tagert 1991).

*Shortspine Thornyhead* (*Sebastolobus alascanus*) are found from northern Baja California to the Bering Sea and occasionally to the Commander Islands north of Japan (Jacobson & Vetter 1996). They are common from southern California northward (Love 1991). Shortspine thornyhead inhabit areas over the continental shelf and slope (Erickson & Pikitch 1993, Wakefield & Smith 1990). Although they can occur as shallow as 26 m (Eschmeyer et al. 1983), shortspine thornyhead mainly occur between 100 and 1400 m off Oregon and California, most commonly between 100-1000 m (Jacobson & Vetter 1996).

Spawning occurs in February and March off California (Wakefield & Smith 1990). Shortspine thornyhead are thought to be oviparous (Wakefield & Smith 1990), although there is no clear evidence to substantiate this (Erickson & Pikitch 1993). Eggs rise to the surface to develop and hatch. Larvae are pelagic for about 12-15 months. During January to June, juveniles settle onto the continental shelf and then move into deeper water as they become adults (Jacobson & Vetter 1996). Off California, they begin to mature at 5 years; 50% are mature by 12-13 years; and all are mature by 28 years (Owen & Jacobson 1992). Although it is difficult to determine the age of older individuals, Owen and Jacobson (1992) report that off California, they may live to over 100 years of age. The mean size of shortspine thornyhead increases with depth and is greatest at 1000-1400 m (Jacobson & Vetter 1996).

Benthic individuals are sit-and-wait predators that rest on the bottom and remain motionless for extended periods of time (Jacobson & Vetter 1996). Off Alaska, shortspine thornyhead eat a variety of invertebrates such as shrimps, crabs, and amphipods, as well as fishes and worms (Owen & Jacobson 1992). Longspine thornyhead are a common item found in the stomachs of shortspine thornyhead. Cannibalism of newly settled juveniles is important in the life history of thornyheads (Jacobson & Vetter 1996).

*Longspine Thornyhead* (*Sebastolobus altivelis*) are found from the southern tip of Baja California to the Aleutian Islands (Eschmeyer et al. 1983, Jacobson & Vetter 1996, Love 1991, Miller & Lea 1972, Smith & Brown 1983) but are abundant from southern California northward (Love 1991). Juvenile and adult longspine thornyhead are demersal and occupy the sediment surface (Smith & Brown 1983). Off Oregon and California, longspine thornyhead mainly occur at depths of 400-1400+ m, most between 600 and 1000 m in the oxygen minimum zone (Jacobson & Vetter 1996). Thornyhead larvae (Sebastolobus spp.) have been taken in research surveys up to 560 km off the California coast (Cross 1987, Moser et al. 1993). Juveniles settle on the continental slope at about 600-1200 m (Jacobson & Vetter 1996). Longspine thornyhead live on soft bottoms, preferably sand or mud (Eschmeyer et al. 1983, Jacobson & Vetter 1996, Love 1991). Longspine thornyheads neither school nor aggregate (Jacobson & Vetter 1996).

Spawning occurs in February and March at 600-1000 m (Jacobson & Vetter 1996, Wakefield & Smith 1990). Longspine thornyhead are oviparous and are multiple spawners, spawning 2-4 batches per season (Love 1991, Wakefield & Smith 1990). Eggs rise to the surface to develop and hatch. Floating egg masses can be seen at the surface in March, April, and May (Wakefield & Smith 1990). Juveniles (<5.1 cm long) occur in midwater (Eschmeyer et al. 1983). After settling, longspine thornyhead are completely benthic (Jacobson & Vetter 1996). Longspine thornyhead can grow to 38 cm (Eschmeyer et al. 1983, Jacobson & Vetter 1996, Miller & Lea 1972) and live more than 40 years (Jacobson & Vetter 1996). Longspine thornyhead reach the onset of sexual maturity at 17-19 cm TL (10% of females mature) and 90% are mature by 25-27 cm (Jacobson & Vetter 1996).

Longspine thornyhead are sit-and-wait predators (Jacobson & Vetter 1996). They consume fish fragments, crustaceans, bivalves, and polychaetes and occupy a tertiary consumer level in the food web. Pelagic juveniles prey largely on herbivorous euphausiids and occupy a secondary consumer level in the food web (Love 1991, Smith & Brown 1983). Longspine thornyhead are commonly seen in shortspine thornyhead stomachs. Cannibalism in newly settled longspine thornyhead may occur because juveniles settle directly onto adult habitat (Jacobson & Vetter 1996). Sablefish commonly prey on longspine thornyhead.

*Darkblotched rockfish* (*Sebastes crameri*) are found from Santa Catalina Island off southern California to the Bering Sea (Miller & Lea 1972, Richardson & Laroche 1979). Off Oregon, Washington, and British Columbia, it is primarily an outer shelf/upper slope species (Richardson & Laroche 1979). Distinct population groups have been found off the Oregon coast between lat. 44 30' and 45 20'N (Richardson & Laroche 1979). Adults occur in depths of 25-600 m and 95% are between 50 and 400 m (Allen & Smith 1988). Off central California, young darkblotched rockfish recruit to soft substrate and low (<1 m) relief reefs (Love et al. 1991). Darkblotched rockfish make limited migrations after they have recruited to the adult stock (Gunderson 1997).

Darkblotched rockfish are viviparous (Nichol & Pickitch 1994). Insemination of female darkblotched rockfish occurs from August to December, fertilization and parturition occurs from December to March off Oregon and California, primarily in February off Oregon and Washington (Hart 1973, Nichol & Pickitch 1994, Richardson & Laroche 1979). Females attain 50% maturity at a greater size (36.5 cm) and age (8.4 years) than males (29.6 cm and 5.1 years) (Nichol & Pickitch 1994). Adults can grow to 57 cm (Hart 1973). Pelagic young are food for albacore (Hart 1973).

*Yelloweye rockfish* (*Sebastes ruberrimus*) range from the Aleutian Islands, Alaska to northern Baja California; they are common from central California northward to the Gulf of Alaska (Eschmeyer et al. 1983, Hart 1973, Love 1991, Miller & Lea 1972, O'Connell & Funk 1986). Yelloweye rockfish occur in water 25-550 m deep; 95% of survey catches occurred from 50 to 400 m (Allen & Smith 1988). Yelloweye

rockfish are bottom dwelling, generally solitary, rocky reef fish, found either on or just over reefs (Eschmeyer et al. 1983, Love 1991, O'Connell & Funk 1986). Boulder areas in deep water (>180 m) are the most densely-populated habitat type and juveniles prefer shallow-zone broken-rock habitat (O'Connell & Carlile 1993). They also reportedly occur around steep cliffs and offshore pinnacles (Rosenthal et al. 1982). The presence of refuge spaces is an important factor affecting their occurrence (O'Connell & Carlile 1993).

Yelloweye rockfish are ovoviviparous and give birth to live young in June off Washington (Hart 1973). The age of first maturity is estimated at 6 years and all are estimated to be mature by 8 years (Echeverria 1987). Yelloweye rockfish can grow to 91 cm (Eschmeyer et al. 1983, Hart 1973). Males and females probably grow at the same rates (Love 1991, O'Connell & Funk 1986). The growth rate of yelloweye rockfish levels off at approximately 30 years of age (O'Connell & Funk 1986). Yelloweye rockfish can live to be 114 years old (Love 1991, O'Connell & Funk 1986). Yelloweye rockfish are a large predatory reef fish that usually feeds close to the bottom (Rosenthal et al. 1988). They have a widely varied diet, including fish, crabs, shrimps and snails, rockfish, cods, sand lances and herring (Love 1991). Yelloweyes have been observed underwater capturing smaller rockfish with rapid bursts of speed and agility. Off Oregon the major food items of the yelloweye rockfish include cancroid crabs, cottids, righteye flounders, adult rockfishes, and pandalid shrimps (Steiner 1978). Quillback and yelloweye rockfish have many trophic features in common (Rosenthal et al. 1988).

*Cowcod (Sebastes levis)* occur from Ranger Bank and Guadalupe Island, Baja California to Usal, Mendocino County, California (Miller & Lea 1972). Cowcod range from 21 to 366 m (Miller & Lea 1972) and is considered to be parademersal (transitional between a midwater pelagic and benthic species). Adults are commonly found at depths of 180-235 m and juveniles are most often found in 30-149 m of water (Love et al. 1990). MacGregor (MacGregor 1986) found that larval cowcod are almost exclusively found in southern California and may occur many miles offshore. Adult cowcod are primarily found over high relief rocky areas (Allen 1982); they are generally solitary, but occasionally aggregate (Love et al. 1990). Solitary subadult cowcod have been found in association with large white sea anemones on outfall pipes in Santa Monica Bay (Allen 1982). Juveniles occur over sandy bottom and solitary ones have been observed resting within a few centimeters of soft-bottom areas where gravel or other low relief was found (Allen 1982). Although the cowcod is generally not migratory; it may move to some extent to follow food (Love 1980). Cowcod are ovoviviparous, and large females may produce up to three broods per season (Love et al. 1990). Spawning peaks in January in the Southern California Bight (MacGregor 1986). Cowcod grow to 94 cm (Allen 1982). Larvae are extruded at about 5.0 mm (MacGregor 1986). Juveniles eat shrimp and crabs and adults eat fish, octopus, and squid (Allen 1982).

*Bank rockfish* (*Sebastes rufus*) are found from Newport, Oregon, to central Baja California, most commonly from Fort Bragg southward (Love 1992). Bank rockfish occur offshore (Eschmeyer et al. 1983) from depths of 31 to 247 m (Love 1992), although adults prefer depths over 210 m (Love et al. 1990). Observations of commercial catches indicate juveniles occupy the shallower part of the species range (Love et al. 1990). Bank rockfish are a midwater, aggregating species that is found over hard bottom (Love 1992), over high relief or on bank edges (Love et al. 1990), and along the ledge of Monterey Canyon (Sullivan 1995). It also frequents deep water over muddy or sandy bottom (Miller & Lea 1972). Spawning ranges from December to May (Love et al. 1990). Peak spawning in the Southern California Bight is January, in central and northern California it is February. Off California, bank rockfish are multiple brooders (Love et al. 1990). Females grow to a larger maximum size (50 cm) than males (44 cm), but grow at a slightly slower rate (Cailliet et al. 1996). Males reach first maturity at 28 cm, 50% maturity at 31 cm, and 100% at 38 cm. Females reach first maturity at 31 cm, 50% at 36 cm, and 100% maturity at 39 cm (Love et al. 1990). Bank rockfish are midwater feeders, eating mostly gelatinous planktonic organisms such as tunicates, but also preying on small fishes and krill (Love 1992).

*Black rockfish* (*Sebastes melanops*) are found from southern California (San Miguel Island) to the Aleutian Islands (Amchitka Island), and they occur most commonly from San Francisco northward (Hart 1973, Miller & Lea 1972, Phillips 1957, Stein & Hassler 1989). Black rockfish occur from the surface to greater

than 366 m, however they are most abundant at depths less than 54 m (Stein & Hassler 1989). Off California, black rockfish are found along with the blue, olive, kelp, black-and-yellow, and gopher rockfishes (Hallacher & Roberts 1985) Adults are usually observed well up in the water column (Hallacher & Roberts 1985). The abundance of black rockfish in shallow water declines in the winter and increases in the summer (Stein & Hassler 1989). Densities of black rockfish decrease with depth during both the upwelling and non-upwelling seasons (Hallacher & Roberts 1985, PFMC 1996). Off Oregon larger fish seem to be found in deeper water (20-50 m) (Stein & Hassler 1989). Black rockfish off the northern Washington coast and outer Strait of Juan de Fuca exhibit no significant movement. However, fish appear to move from the central Washington coast southward to the Columbia River, but not into waters off Oregon. Movement displayed by black rockfish off the northern Oregon coast is primarily northward to the Columbia River (Culver 1986). Black rockfish form mixed sex, midwater schools, especially in shallow water (Hart 1973, Stein & Hassler 1989). Black rockfish larvae and young juveniles (<40-50 mm) are pelagic but are benthic at larger sizes (Laroche & Richardson 1980).

Black rockfish have internal fertilization and annual spawning (Stein & Hassler 1989). Parturition occurs from February-April off British Columbia, January-March off Oregon, and January-May off California (Stein & Hassler 1989). Spawning areas are unknown, but spawning may occur in offshore waters because gravid females have been caught well offshore (Dunn & Hitz 1969, Hart 1973, Stein & Hassler 1989). Black rockfish can live to be more than 20 years in age. The maximum length attained by the black rockfish is 60 cm (Hart 1973, Stein & Hassler 1989). Off Oregon, black rockfish primarily prey on pelagic nekton (anchovies and smelt) and zooplankton such as salps, mysids, and crab megalops. Off central California, juveniles eat copepods and zoea, while adults prey on juvenile rockfish, euphausiids, and amphipods during upwelling periods; during periods without upwelling they primarily consume invertebrates. Black rockfish feed almost exclusively in the water column (Culver 1986). Black rockfish are known to be eaten by lingcod and yelloweye rockfish (Stein & Hassler 1989).

*Blackgill rockfish (Sebastes melanostomus)* are distributed from Washington to Punta Abreojos (Love 1991, Moser & Ahlstom 1978). Adult blackgill rockfish are found offshore at depths of 219-768 m (Eschmeyer et al. 1983). Blackgill rockfish usually inhabit rocky or hard bottom habitats, along steep drop-offs, such as the edges of submarine canyons and over seamounts (Love 1991). However, they may also occur over soft-bottoms (Eschmeyer et al. 1983). Blackgill rockfish are a transitional species, occupying both midwater and benthic habitats (Love et al. 1990), although they are rarely taken at more than 9 m above the bottom (Love 1991). Blackgill are considered an aggregating species (Love 1991).

Blackgill rockfish spawn from January-June (peaking in February) off southern California, and in February off central and northern California (Love 1991, Love et al. 1990, Moser & Ahlstom 1978). The largest blackgill rockfish on record is 61 cm (Eschmeyer et al. 1983, Love 1991, Love et al. 1990). Blackgill rockfish primarily prey on such planktonic prey as euphausids and pelagic tunicates, as well as small fishes (e.g., juvenile rockfishes and hake, anchovies and lantern fishes) and squid (Love et al. 1990).

*Redstripe rockfish (Sebastes proriger)* occur from San Diego, California to the Bering Sea (Allen & Smith 1988, Hart 1973, Miller & Lea 1972). Redstripe rockfish inhabits the outer shelf and upper slope and are most common between 100 and 350 m (Allen & Smith 1988). Adults are semi-demersal, while larvae and juveniles are pelagic to semi-demersal (Garrison & Miller 1982). Young redstripe rockfish can occur in estuaries (Kendall & Lenarz 1986). Redstripe rockfish are generally found slightly off the bottom over both high and low relief rocky areas (Starr et al. 1996). Redstripe rockfish are very sedentary, exhibiting little or no movement from a home habitat or range (Matthes et al. 1986).

Redstripe rockfish are ovoviviparous (Garrison & Miller 1982). Off Oregon, larvae are released between April and July, but later off northern and central California, during July through September (Kendall & Lenarz 1986). Redstripe rockfish may grow to reach 61 cm (Hart 1973). Larvae and juveniles of this species were found to feed primarily on copepods, their eggs, and copepod nauplii, as well as all stages of euphausiids (Kendall & Lenarz 1986). Food of adult redstripe rockfish consists of small fish such as anchovies, herring and early stages of other groundfish, as well as squid (Starr et al. 1996). Redstripe

rockfish may compete for food and habitat resources with widow, squarespot, shortbelly, and canary rockfishes, as well as lingcod and spiny dogfish (Erickson et al. 1991).

*Sharpchin rockfish (Sebastes zacentrus)* occur from San Diego, California, to the Aleutian Islands, Alaska (Allen & Smith 1988). Sharpchin rockfish occur from 25 to 475 m, but about 96% occur from 100 to 350 m (Allen & Smith 1988). Sharpchin rockfish can occur over soft bottoms (Eschmeyer et al. 1983), but they apparently prefer mud and cobble substrate and are associated with boulder and cobble fields (Stein et al. 1992). Parturition occurs from March through July off Oregon and from May through June off northern and central California (Echeverria 1987). Shortraker rockfish can grow to 33 cm (Miller & Lea 1972).

*Silvergrey Rockfish (Sebastes brevispinis)* are found from Santa Barbara Island, southern California, to the Bering Sea (Allen & Smith 1988, Hart 1973). Silvergray rockfish are included in the shelf rockfish assemblage (Hart 1973, Nagtegaal 1983) and inhabit the outer shelf-mesobenthal zone (Allen & Smith 1988). They occur in depths from 0 to 375 m with 95% of survey catches taken in depths of 100 to 300 m (Allen & Smith 1988). Off Oregon, young are probably released in late spring or summer (Hart 1973, Allen & Smith 1988). Off Washington, young are released in June (Hart 1973). They achieve a maximum size of 71 cm (Hart 1973).

*Yellowmouth rockfish (Sebastes reedi)* occur from Sitka, Alaska to Point Arena, California. Yellowmouth rockfish occupy a depth range from 137-366 m (Miller & Lea 1972) usually 275-366 m over rough bottom (Kramer et al. 1995). Off Oregon, yellowmouth rockfish release their young from February through June (Kendall & Lenarz 1986). Yellowmouth females mature at 33 cm or larger (9 years old), and males mature at lengths greater than 31 cm (9 years old). They grow to 54 cm and can live to 34 years of age (Hart 1973).

*"Other Rockfish"* are those rockfish species that do not have individual ABC/OYs. Life history descriptions of these species may be found in the Essential Fish Habitat West Coast Groundfish which was prepared for Amendment 11 to the FMP. This document may be requested from the Council office or is available online at http://www.nwr.noaa.gov/1sustfsh/efhappendix/page1.html

*"OTHER FISH"* are those groundfish species that do not have individual ABC/OYs. Life history descriptions of these species may be found in the Essential Fish Habitat West Coast Groundfish which was prepared for Amendment 11 to the FMP. This document may be requested from the Council office or is available online at http://www.nwr.noaa.gov/1sustfsh/efhappendix/page1.html

### 3.2.4 Endangered Species

West Coast marine species listed as endangered or threatened under the Endangered Species Act (ESA) are discussed below in sections 3.2.5 (Marine Mammals,) 3.2.6 (Seabirds,) 3.2.7 (Sea Turtles,) and 3.2.8 (Salmon). Under the ESA, a species is listed as "endangered" if it is in danger of extinction throughout a significant portion of its range and "threatened" if it is likely to become an endangered species within the foreseeable future throughout all, or a significant portion, of its range. The following species are subject to the conservation and management requirements of the ESA:

| Table 3.2.3 West Coast Endangered Species |
|---|
| Marine Mammals |
| Threatened:<br>• Steller sea lion (*Eumetopias jubatus*) Eastern Stock,<br>• Guadalupe fur seal (*Arctocephalus townsendi*), and<br>• Southern sea otter (*Enhydra lutris*) California Stock. |
| Seabirds |
| Endangered:<br>• Short-tail albatross (*Phoebastria (=Diomedea) albatrus*),<br>• California brown pelican (*Pelecanus occidentalis*), and<br>• California least tern (*Sterna antillarum browni*).<br><br>Threatened:<br>• Marbled murrelet (*Brachyramphs marmoratus*). |
| Sea Turtles |
| Endangered:<br>• Green turtle (*Chelonia mydas*)<br>• Leatherback turtle (*Dermochelys coriacea*)<br>• Olive ridley turtle (*Lepidochelys olivacea*)<br><br>Threatened:<br>• Loggerhead turtle (*caretta*) |
| Salmon |
| Endangered:<br>• Chinook salmon (*Oncorhynchus tshawytscha)*<br>Sacramento River Winter; Upper Columbia Spring<br>• Sockeye salmon (*Oncorhynchus nerka)*<br>Snake River<br>• Steelhead trout (*Oncorhynchus mykiss)*<br>Southern California; Upper Columbia<br><br>Threatened:<br>• Coho salmon (*Oncorhynchus kisutch)*<br>Central California, Southern Oregon, and Northern California Coasts<br>• Chinook salmon (*Oncorhynchus tshawytscha*)<br>Snake River Fall, Spring, and Summer; Puget Sound; Lower Columbia; Upper Willamette; Central Valley Spring; California Coastal<br>• Chum salmon (*Oncorhynchus keta)*<br>Hood Canal Summer; Columbia River<br>• Sockeye salmon (*Oncorhynchus nerka)*<br>Ozette Lake<br>• Steelhead trout (*Oncorhynchus mykiss)*<br>South-Central California, Central California Coast, Snake River Basin, Lower Columbia, California Central Valley, Upper Willamette, Middle Columbia, Northern California |

### 3.2.5 Marine Mammals

The waters off Washington, Oregon, and California (WOC) support a wide variety of marine mammals. Approximately thirty species, including seals and sea lions, sea otters, and whales, dolphins, and porpoise, occur within the EEZ. Many marine mammal species seasonally migrate through West Coast waters, while others are year round residents.

There is limited information documenting the interactions of groundfish fisheries and marine mammals, but marine mammals are probably affected by many aspects of groundfish fisheries. The incidental take of marine mammals, defined as any serious injury or mortality resulting from commercial fishing operations, is reported to NMFS by vessel operators. In the West Coast groundfish fisheries, incidental take is

infrequent and primarily occurs in trawl fisheries (Forney *et al.* 2000). Indirect effects of groundfish fisheries on marine mammals are more difficult to quantify due to a lack of behavioral and ecological information about marine mammals. However, marine mammals may be affected by increased noise in the oceans, change in prey availability, habitat changes due to fishing gear, vessel traffic in and around important habitat (i.e., areas used for foraging, breeding, raising offspring, or hauling-out), at-sea garbage dumping, and diesel or oil discharged into the water associated with commercial fisheries.

The Marine Mammal Protection Act (MMPA) and the ESA are the federal legislation that guide marine mammal species protection and conservation policy. Under the MMPA on the West Coast, NMFS is responsible for the management of cetaceans and pinnipeds, while the U.S. Fish and Wildlife Service (FWS) manages sea otters. Stock assessment reports review new information every year for strategic stocks (those whose human-caused mortality and injury exceeds the potential biological removal [PBR]) and every three years for non-strategic stocks. Marine mammals whose abundance falls below the optimum sustainable population (OSP) are listed as "depleted" according to the MMPA.

Fisheries that interact with species listed as depleted, threatened, or endangered may be subject to management restrictions under the MMPA and ESA. NMFS publishes an annual list of fisheries in the Federal Register separating commercial fisheries into one of three categories, based on the level of serious injury and mortality of marine mammals occurring incidentally in that fishery. The categorization of a fishery in the list of fisheries determines whether participants in that fishery are subject to certain provisions of the MMPA, such as registration, observer coverage, and take reduction plan requirements. The WOC groundfish fisheries are in Category III, indicating a remote likelihood of, or no known serious injuries or mortalities, to marine mammals.

Of the marine mammal species incidentally caught in WOC groundfish fisheries, the Steller sea lion is listed as threatened under the ESA, the northern elephant seal may be within their OSP range, and there is insufficient data to determine the status of the harbor seal, California sea lion, Dall's porpoise, and Pacific white-sided dolphin relative to their OSP. None of these species are classified as strategic stocks under the MMPA. Based on its Category III status, the incidental take of marine mammals in the WOC groundfish fisheries does not significantly impact marine mammal stocks.

### 3.2.6 Seabirds

Over sixty species of seabirds occur in waters off the coast of WOC within the EEZ. These species include: loons, grebes, albatross, fulmars, petrels, shearwaters, storm-petrels, pelicans, cormorants, frigate birds, phalaropes, skuas, jaegers, gulls, kittiwakes, skimmers, terns, guillemots, murrelets, auklets, and puffins. The migratory range of these species includes commercial fishing areas; fishing also occurs near the breeding colonies of many of these species.

Interactions between seabirds and fishing operations are wide-spread and have led to conservation concerns in many fisheries throughout the world. Abundant food in the form of offal (discarded fish and fish processing waste) and bait attract birds to fishing vessels. Of the gear used in the groundfish fisheries on the West Coast, seabirds are occasionally taken incidentally by trawl and pot gear, but they are most often taken by longline gear. Around longline vessels, seabirds forage for offal and bait that has fallen off hooks at or near the water's surface and are attracted to baited hooks near the water's surface during the setting of gear. If a bird becomes hooked while feeding on bait or offal, it can be dragged underwater and drowned. Of the incidental catch of seabirds by longline groundfish fisheries in Alaska, northern fulmars represented about 66% of the total estimated catch of all bird species, gulls contributed 18%, Laysan albatross 5%, and black-footed albatross about 4% (Stehn *et al.* 2001). Longline gear and fishing strategies in Alaska are similar to some, but not all, of those used in WOC longline fisheries.

Besides entanglement in fishing gear, seabirds may be indirectly affected by commercial fisheries in various ways. Change in prey availability may be linked to directed fishing and the discarding of fish and offal. Vessel traffic may affect seabirds when it occurs in and around important foraging and breeding

habitat and increases the likelihood of bird storms. In addition, seabirds may be exposed to at-sea garbage dumping and the diesel and oil discharged into the water associated with commercial fisheries. The FWS is the primary federal agency responsible for seabird conservation and management. Under the Magnuson-Stevens Act, NMFS is required to ensure fishery management actions comply with other laws designed to protect seabirds.

### 3.2.7 Sea Turtles

Sea turtles are highly migratory; four of the six species found in U.S. waters have been sighted off the West Coast. Little is known about the interactions between sea turtles and West Coast commercial fisheries. The directed fishing for sea turtles in WOC groundfish fisheries is prohibited, because of their ESA listings, but the incidental take of sea turtles by longline or trawl gear may occur. Sea turtles are known to be taken incidentally by the California-based pelagic longline fleet and the California halibut gillnet fishery. Because of differences in gear and fishing strategies between those fisheries and the WOC groundfish fisheries, the expected take of sea turtles by groundfish gear is minimal. The management and conservation of sea turtles is shared between NMFS and FWS.

Sea turtles may be also indirectly affected by commercial fisheries. Sea turtles are vulnerable to collisions with vessels and can be killed or injured when struck, especially if struck with an engaged propeller. Entanglement in abandoned fishing gear can also cause death or injury to sea turtles by drowning or loss of a limb. The discard of garbage at sea can be harmful for sea turtles, because the ingestion of such garbage may choke or poison them. Sea turtles have ingested plastic bags, beverage six-pack rings, styrofoam, and other items commonly found aboard fishing vessels. The accidental discharge of diesel and oil from fishing vessels may also put sea turtles at risk, as they are sensitive to chemical contaminates in the water.

### 3.2.8 Salmon

Salmon caught in the U.S. West Coast fishery have life cycle ranges that include coastal streams and river systems from central California to Alaska and oceanic waters along the U.S. and Canada seaward into the north central Pacific Ocean, including Canadian territorial waters and the high seas. Some of the more critical portions of these ranges are the freshwater spawning grounds and migration routes.

Chinook or king salmon (*Oncorhynchus tshawytscha*) and coho or silver salmon (*O. kisutch*) are the main species caught in Council-managed ocean salmon fisheries. In odd-numbered years, catches of pink salmon (*O. gorbuscha*) can also be fairly large, primarily off Washington and Oregon. Ocean salmon are caught with commercial and recreational troll gear. No other gears are allowed to take and retain salmon in the ocean fisheries. Small amounts of rockfish and other groundfish are taken as incidental catch in salmon troll fisheries.

NMFS issued Biological Opinions under the ESA on August 10, 1990, November 26, 1991, August 28, 1992, September 27, 1993, May 14, 1996, and December 15, 1999 pertaining to the effects of the groundfish fishery on chinook salmon (Puget Sound, Snake River spring/summer, Snake River fall, upper Columbia River spring, lower Columbia River, upper Willamette River, Sacramento River winter, Central Valley, California coastal), coho salmon (Central California coastal, southern Oregon/northern California coastal, Oregon coastal), chum salmon (Hood Canal, Columbia River), sockeye salmon (Snake River, Ozette Lake), and steelhead (upper, middle and lower Columbia River, Snake River Basin, upper Willamette River, central California coast, California Central Valley, south-central California, northern California, southern California).

### 3.2.9 Nongroundfish Species Interactions

**Coastal Pelagic Species (CPS)** CPS are schooling fish, not associated with the ocean bottom, that migrate in coastal waters. These species include: northern anchovy (*Engraulis mordax*), Pacific sardine

(*Sardinops sagax*), Pacific (chub) mackerel (*Scomber japonicus*), jack mackerel (*Trachurus symmetricus*) and market squid (*Loligo opalescens*). These species are managed under the Coastal Pelagic Species Fishery Management Plan.

Sardines inhabit coastal subtropical and temperate waters and at times have been the most abundant fish species in the California current. During times of high abundance, Pacific sardine range from the tip of Baja California to southeastern Alaska. When abundance is low, Pacific sardine do not occur in large quantities north of Point Conception, California. Pacific (chub) mackerel in the northeastern Pacific range from Banderas Bay, Mexico to southeastern Alaska. They are common from Monterey Bay, California to Cabo San Lucas, Baja California, and most abundant south of Point Conception, California. The central subpopulation of northern anchovy ranges from San Francisco, California to Punta Baja, Mexico. Jack mackerel are a pelagic schooling fish that range widely throughout the northeastern Pacific, however much of their range lies outside the U.S. EEZ. Adult and juvenile market squid are distributed throughout the Alaska and California current systems, but are most abundant between Punta Eugenio, Baja California and Monterey Bay, Central California.

CPS are taken incidentally in the groundfish fishery. Incidental take is well documented in the at-sea and shore-based whiting fishery. Preliminary data for 2001 indicates approximately 321mt of jack mackerel, 469 mt of Pacific mackerel, and 55 mt of squid was incidentally taken in the at-sea whiting fishery. There is little information on the incidental take of CPS by the other segments of the fishery, however given CPS are not associated with the ocean bottom, the interaction is expected to be minimal.

**Dungeness Crab** The Dungeness crab (*Cancer magister*) is distributed from the Aleutian Islands, Alaska, to Monterey Bay, California. They live in bays, inlets, around estuaries, and on the continental shelf. Dungeness crab are found to a depth of about 180 m. Although it is found at times on mud and gravel, this crab is most abundant on sand bottoms; frequently it occurs among eelgrass. The Dungeness crab, which are typically harvested using traps (crab pots), ring nets, by hand (scuba divers) or dip nets, are incidentally taken or harmed by groundfish gears.

**Pacific Pink Shrimp** Pacific pink shrimp (*Pandalus jordani*) are found from Unalaska in the Aleutian Islands to San Diego, California, at depths of 25 to 200 fm (46 to 366 m). Off the U.S. West Coast these shrimp are harvested with trawl gear from northern Washington to central California between 60 and 100 fm (110 to 180 m). The majority of the catch is taken off the coast of Oregon. Concentrations of pink shrimp are associated with well-defined areas of green mud and muddy-sand bottom. Shrimp trawl nets are usually constructed with net mesh sizes smaller than the net mesh sizes for legal groundfish trawl gear. Thus, it is shrimp trawlers that commonly take groundfish in association with shrimp, rather than the reverse.

**Pacific Halibut** Halibut (*Hippoglossus stenolepis*) belong to a family of flounders called Pleuronectidae. Halibut are usually found in deep water (40 to 200 m). The International Pacific Halibut Commission (IPHC) report, "Incidental Catch and Mortality of Pacific Halibut, 1962-2000" contains estimates of the incidental catches of halibut in the coastal trawl fisheries (groundfish and shrimp trawls). Estimates of incidental catches of halibut, based on the at-sea observer data collected in the Enhanced Data Collection Program conducted from 1995 through 1998, results in an estimated mortality level of legal-sized halibut incidentally taken in shrimp and groundfish trawl fisheries was 254 mt (560,000 pounds) in 2002.

**Forage Fish** Forage fish are small, schooling fish that serve as an important source of food for other fish species, birds and marine mammals. Examples of forage fish species are herring (*Clupea harengus pallasi*), smelt (*Osmeridae*), anchovies, and sardine. Many species of fish feed on forage fish. Major predators of herring include Pacific cod (42% of diet), whiting (32%), lingcod (71%), halibut (53%), coho (58%), and chinook salmon (58%) (Environment Canada 1994). Many species of seabirds depend heavily on forage fish for food as well. Marine mammals consuming forage fish include: harbor seals, California sea lions, Stellar sea lions, harbor porpoises, Dall's porpoises, and Minke whales (Calambokidis and Baird 1994). Forage fish are most commonly found in nearshore waters and within bays and estuaries, although

some do spend of their lives in the open ocean where they may be incidentally taken by groundfish gears, particularly in trawls. Preliminary data from the 2002 at-sea whiting fishery indicates the fishery encounters very minor amounts of forage fish species (Pacific herring less than 1 mt and less than 1 mt of smelt and sardines combined). There is little information on the incidental take of forage fish by the other segments of the fishery, however given they are not associated with the ocean bottom, the interaction is expected to be minimal.

**Miscellaneous Species** Little information is available on nongroundfish species incidentally captured in the groundfish fishery. Other than those species mentioned above, documentation from the whiting fishery indicates species such as American shad and walleye pollock are taken incidentally. American shad, introduced in 1885, have flourished throughout the lower Columbia River, producing a record run of 2.2 million fish in 1988 (ODFW and WDFW 1989). American shad was also taken in the shore-based whiting fishery. Walleye pollock are found in the waters of the Northeastern Pacific Ocean from the Sea of Japan, north to the Sea of Okhotsk, east in the Bering Sea and Gulf of Alaska, and south in the Northwestern Pacific Ocean along the Canadian and U.S. West Coast to Carmel, California.

## 3.3 HUMAN ENVIRONMENT

### 3.3.1 History of Management Via Annual Specifications and Management Measures

Washington, Oregon, and California have been managing groundfish fisheries off of their coasts since the early 20th century. Then, as now, many fisheries straddled state borders, with vessels operating offshore of their home states and offshore of neighboring states. Congress recognized the West Coast need for a coordinating body that would ensure compatible management and regulation between states in 1947 by forming the Pacific States Marine Fisheries Commission (PSMFC). Since then, PSMFC has served in a coordinating role for fisheries management issues in common between the three West Coast states, Alaska, and Idaho. The Fishery Conservation and Management Act (now amended and renamed as the Magnuson-Stevens Fishery Conservation and Management Act) went into effect in 1977, extending exclusive economic zones (EEZs) out to 200 nautical miles offshore and forming fishery management councils to manage the fisheries occurring within EEZ waters. From 1977 through 1982, the three states coordinated groundfish management through the Pacific Fishery Management Council (Council,) during which time the Council also developed its initial FMP for groundfish (Council, March 1998).

In September 1982, the groundfish FMP went into effect. Under the FMP, the Council was authorized to set annual optimum yields (OYs) for Pacific whiting, Pacific ocean perch (POP,) shortbelly rockfish, widow rockfish, and sablefish. These particular species were the first chosen for OY harvest limitations due to their contributions to foreign catch (Pacific whiting and shortbelly rockfish) or to their importance to domestic harvest (sablefish and widow rockfish.) In the case of POP, which had been overfished by the foreign fisheries in the 1960s and 1970s, an OY was needed to set the species on a rebuilding schedule. Federal groundfish fishery regulations intended to keep the harvest of these species within their OYs and of other groundfish within their Acceptable Biological Catches (ABCs) were relatively brief and simple. These regulations were published in the *Federal Register*, to be modified if and when the fisheries approached an ABC or OY for a managed species.

By 1987, the Council had realized that its relatively simple and straightforward FMP was too inflexible to allow regular adjustments to harvest levels and regulatory restrictions. For example, the FMP had to be amended each time the Council wished to set an OY for a species that had not previously been managed with OYs. Amendment 4 to the FMP was intended to address some of the inefficiencies of the initial FMP by creating processes by which the Council would discuss and make decisions on long-term permanent changes to regulations, on annual specifications of ABCs and OYs and management measures to implement those specifications, and on inseason actions to change the annual management measures. Amendment 4 gave the FMP a new procedure for developing and implementing annual specifications and their allocations between different fishery sectors:

> "The Council will develop preliminary recommendations at the first of two meetings (usually in September) based upon the best stock assessment information available to the Council at the time and consideration of public comment. After the first meeting, the Council will provide a summary of its preliminary recommendations and their basis to the public through its mailing list as well as providing copies of the information at the Council office and to the public upon request. The Council will notify the public of its intent to develop final recommendations at its second meeting (usually November) and solicit public comment both before and at its second meeting.
>
> At its second meeting, the Council will again consider the best available stock assessment information which should be contained in the recently completed SAFE (Stock Assessment and Fishery Evaluation) report and consider public testimony before adopting final recommendations to the Secretary (of Commerce.) Following the second meeting, the Council will submit its recommendations along with the rationale and supporting information to the Secretary for review and implementation.
>
> Upon receipt of the Council's recommendations, supporting rationale and information, the Secretary will review the submission and, if approved, publish a notice in the *Federal Register* making the Council's recommendations effective January 1 of the upcoming fishing year." (Council, August 1990)

The Council used this "two-meeting process" followed by the publication of a single *Federal Register* notice to implement the Council's recommendations from 1991-2001. Through that process, the Council could set harvest levels (such as ABCs and OYs) for managed species and management measures intended to allow the fisheries to achieve those harvest levels (trip limits or bag limits, size limits, etc.) Overall federal regulations were amended to include a list of species that could be managed via the annual process and the particular management measures that could be used with those species, called the "routine" management measures. Over time, the Council added new species and new management measures to this list by amending federal regulations when new routine measures were needed.

For both commercial and recreational fisheries, routine management measures have been intended to keep groundfish landings within annual harvest levels. In the commercial fisheries, trip landing and frequency limits were applied as routine management measures for the following reasons: to extend the fishing season; to minimize disruption of traditional fishing and marketing patterns; to reduce discards; to discourage target fishing while allowing small incidental catches to be landed; to allow small fisheries to operate outside the normal season; and, for the open access fishery only, to keep landings at the historical proportions of the 1984-88 window period. Size limits were applied as routine management measures in the commercial fisheries, either to protect juvenile fish or to extend the fishing season. For the recreational fisheries, bag limits have been applied as routine management measures to spread the available catch over a large number of anglers, to avoid waste, or for consistency with state regulations. Size limits were also applied as routine management measures in the recreational fisheries, either to protect juvenile fish, to enhance the quality of the recreational fishing experience, or for consistency with state regulations. (FMP at 6.2.1)

With Amendment 13 to the FMP, the Council set up a two-meeting process for designating new routine management measures that set publication of the routine management measures in its annual SAFE document, rather than in federal regulations. The Council built this additional flexibility into the FMP so that it could act more swiftly on new information about management changes needed to protect overfished species. Under the Amendment 13 revisions to the FMP, routine management measures could be added or changed, "in cases where protection of an overfished or depleted stock is required..." (FMP at 6.2) Amendment 13 also added to the types of routine management measures available to the Council, "In cases where protection of an overfished or depleted stock is required, the Council may impose limits that differ by gear type, or establish closed areas or seasons."

Table 3.3.1 Management Measures Classified as Routine, as of January 2002

| Commercial fisheries: | Recreational fisheries: |
|---|---|
| • Differential limits by gear type may be set for overfished species or for fisheries in which overfished species are caught incidentally.<br>• For all FMP-managed rockfish species, whether individually or within a species group/complex, trip landing and frequency limits may be set. Off California, time/area closures may be set.<br>• For all FMP-managed flatfish species, whether individually or within a species group/complex, trip landing and frequency limits may be set.<br>• For cowcod, time/area closures may be set.<br>• For sablefish and lingcod, trip landing and and frequency limits and size limits may be set. And, for lingcod, time/area closures may be set.<br>• For whiting, trip landing and frequency limits may be set for the offseason. Directed whiting season start dates may be set.<br>• For all groundfish species, separately or in any combination, trip landing and frequency limits may be set for any open access fishery, including exempted trawl fisheries. | • For lingcod off Washington, and Oregon, bag limits, size limits, and closed seasons may be set. For lingcod, cabezon, and kelp greenling off California, bag limits, size limits, boat limits, hook limits, closed areas, and dressing/fileting requirements may be set.<br>• For rockfish off Washington and Oregon, bag limits and size limits may be set. For rockfish off California, bag limits, size limits, boat limits, hook limits, closed areas, and dressing/fileting requirements may be set. |

In 2001, NMFS was challenged on the two-meeting annual specifications and management measures process in Natural Resources Defense Council, Inc. v. Evans, 2001 168 F.Supp. 2d 1149 (N.D. Cal. 2001) Part of the court's ruling in that case required NMFS to provide a *Federal Register* notice-and-comment period as part of the annual specifications and management measures process. To meet the court's requirement for the 2002 specifications and management measures, NMFS published a proposed (67 FR 1555, January 11, 2002) and final rule (67 FR 10490, March 7, 2001) for the overall 2002 specifications and management measures, and an emergency rule to implement management measures for January-February 2002 (67 FR 1540, January 11, 2002). If the agency had not published January-February management measures for 2002, the management measures from January-February 2001 would have remained in effect for that period. NMFS published the emergency rule for the first two months of 2002 because some of the management measures from January-February 2001 were not conservative enough to adequately address rebuilding needs of overfished species. For the 2003 specifications and management measures, the Council will develop its initial specifications and management measures recommendations at its June 2002 meeting, with final recommendations at its September 2002 meeting, to be followed by a NMFS proposed and final rule for the 2003 season.

**Protecting Overfished Species Within the Specifications and Management Measures Process**
The major goal of management of the groundfish fishery throughout the 1990's was to prevent overfishing while achieving the OYs and providing year-round fisheries for the major species or species groups. One of the primary goals of the Pacific coast groundfish FMP is to keep the fishery open throughout the entire year for most segments of the fishery (See FMP goals and objectives at section 2.0). Harvest rates are constrained by annual harvest guidelines, two-month or one-month cumulative period landings limits, individual trip limits, size limits, species-to-species ratio restrictions, bag limits in the recreational fisheries and other measures, all designed to control effort so that the allowable catch is taken at a slow rate that will stretch the season out to a full year. Cumulative period catch limits are set by comparing current or previous landings rates with the year's total available catch. Landings limits have been used to slow the pace of the fishery and stretch the fishing season out over as many months as possible, so that the overall harvest target is not reached until the end of the year.

By 2000, lower OYs and growing awareness of reduced productivity of the groundfish resource had made it apparent that the goal of a year-round fishery was no longer achievable for a number of species. In addition, new legislative mandates under the Magnuson-Stevens Act gave highest priority to preventing overfishing and rebuilding overfished stocks to their MSY levels. The National Standard Guidelines at 50 CFR 600.310 interpreted this as "weak stock management," which means that harvest of healthier stocks

must be curtailed to prevent overfishing or to rebuild overfished stocks. To meet initial rebuilding requirements for the three species declared overfished in 1999, bocaccio, lingcod, and POP, the Council developed a new management strategy that diverts effort off the sea floor of the continental shelf, where many of the overfished species are found. Overfished species protection measures initially applied in 2000 included more restrictive trip limits for continental shelf species, reduced seasons for commercial hook-and-line gear and recreational fisheries off central and southern California, and trawl gear restrictions limiting the species and quantities of groundfish that could be taken with trawl nets using footropes of greater than 8 inches in diameter.

These 2000 restrictions were relatively severe when compared against allowable landings limits in the 1990s. At the urging of their coastal communities, the governors of the three West Coast states asked the Secretary of Commerce, through NMFS, to declare the West Coast groundfish fishery a commercial fishery failure. At the time, NMFS estimated that allowable landings limits in 2000 would reduce the commercial harvest value of West Coast groundfish by 25% from 1999 harvest levels. NMFS did declare the groundfish fisheries to be a commercial fishery failure in January 2000 (Dalton, 2000). In its declaration, NMFS cited the potential causes of the fishery resource disaster to be declining productivity in groundfish stocks associated with recently discovered oceanic regime shifts, advancements in scientific information about West Coast rockfish productivity that showed West Coast rockfish stocks to be generally less productive than many similar rockfish species worldwide.

Since 2000, management measures intended to eliminate directed catch and minimize incidental catch of overfished species have increased in number and in restrictiveness. Although year-round groundfish landings opportunities continue to be available to some gears in some areas, fishing opportunities have been eliminated for many vessels.

Table 3.3.2: Timetable of management measures implemented to protect overfished species through the annual specifications and management measures process

| Year | Species Declared Overfished | Management Measures to Protect Overfished Species (Implemented through Specifications and Management Measures) |
|---|---|---|
| 1999 | lingcod, bocaccio, POP | • These three species were declared overfished in March 1999, after the specifications and management measures had been set for that year. |
| 2000 | canary rockfish, cowcod<br><br>(Management measures to protect lingcod, bocaccio, POP continue.) | • Targeting opportunities for overfished stocks eliminated<br>• Shelf rockfish targeting reduced for hook-and-line gear and for large and small footrope trawl, particularly for healthy stocks closely associated with overfished species (e.g. chilipepper rockfish with bocaccio)<br>• Commercial hook-and-line and recreational fisheries off central and southern California closed 4 months for nearshore and shelf rockfish with rockfish recreational bag limits also reduced<br>• All commercial fisheries closed 6 months coastwide for lingcod with recreational season closures and reduced bag limits for lingcod varying by state. |
| 2001 | widow rockfish, darkblotched rockfish<br><br>(Management measures to protect lingcod, bocaccio, POP, canary rockfish, cowcod continue.) | • Targeting opportunities for overfished stocks eliminated<br>• Shelf rockfish targeting further reduced for hook-and-line gear and for large and small footrope trawl with minimal targeting allowed for midwater trawl gear<br>• Flatfish landings restricted to reduce incidental catch of protected rockfish<br>• Commercial hook-and-line and fisheries off California closed or depth restricted 7 months (central CA) or 5 months (southern CA) for nearshore and shelf rockfish<br>• Recreational fisheries off California closed or depth restricted 6 months (central CA) or 4 months (southern CA) for nearshore and shelf rockfish with overall rockfish recreational bag limits same as in 2000 but species-specific limits reduced for overfished species<br>• All commercial fisheries closed 6 months, except that central CA hook-and-line closed 8 months, for lingcod<br>• Recreational season closures and continued reduced bag limits for lingcod varying by state<br>• Cowcod Conservation Areas introduced to Southern California Bight waters, closed to all fishing for groundfish<br>• Cowcod retention prohibited in all fisheries<br>• Pink shrimp trawlers using fish excluder devices (state-managed fishery) |

| | | |
|---|---|---|
| 2002 | yelloweye rockfish, whiting<br><br>(Management measures to protect lingcod, bocaccio, POP, canary rockfish, cowcod, widow rockfish, darkblotched rockfish continue.) | • Targeting opportunities for all overfished stocks except whiting eliminated. Whiting OY reduced by 20% from 2001<br>• New bycatch analysis used to determine co-occurrence ratios between healthy species and overfished species, allowing more precise setting of healthy species limits to better reduce incidental catch of overfished species<br>• Shelf rockfish targeting further reduced for hook-and-line gear and for all trawl gears<br>• Flatfish landings further restricted to reduce incidental catch of protected rockfish<br>• Commercial hook-and-line and recreational fisheries off California closed or depth restricted10 months (central CA) or 4 months (southern CA) for nearshore and shelf rockfish Commercial hook-and-line and recreational fisheries off central and southern California closed 4 months for nearshore and shelf rockfish with rockfish recreational bag limits also reduced<br>• Commercial hook-and-line fisheries closed 6 months, except that central CA hook-and-line closed or depth restricted 8 months, for lingcod<br>• Recreational season closures and continued reduced bag limits for lingcod varying by state<br>• Cowcod Conservation Areas continue, cowcod retention continues to be prohibited<br>• Yelloweye rockfish and canary rockfish retention prohibited in commercial hook-and-line fisheries, reduced or prohibited in recreational fisheries, reduced in trawl fisheries.<br>• Pink shrimp trawlers using fish excluder devices (state-managed fishery)<br>• Pacific halibut sport fishery closed area expanded to protect co-occurring yelloweye rockfish (state-managed fishery) |

Figure 3.3.1

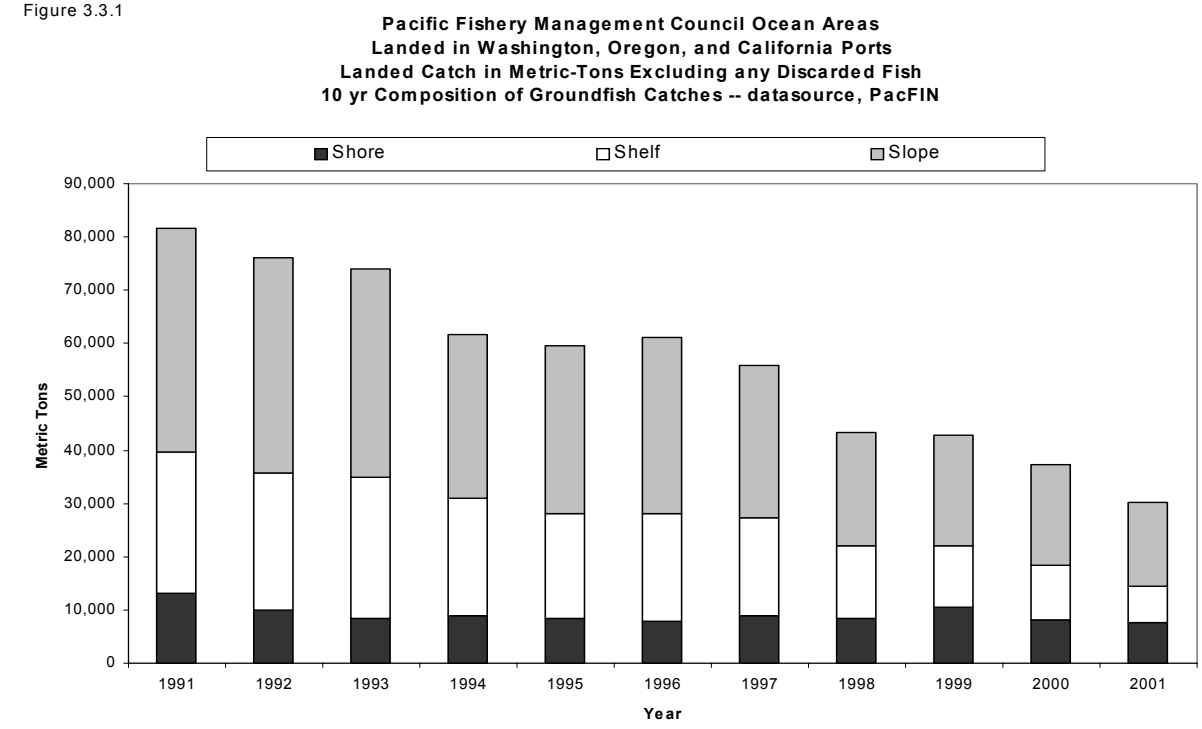
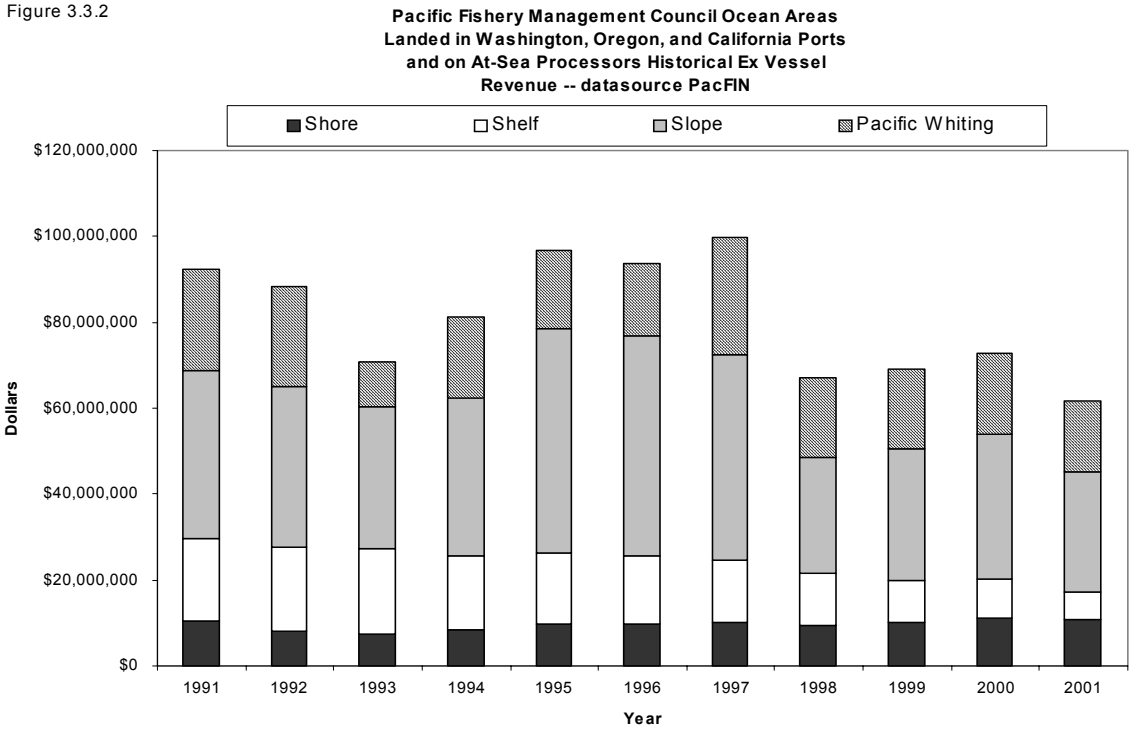


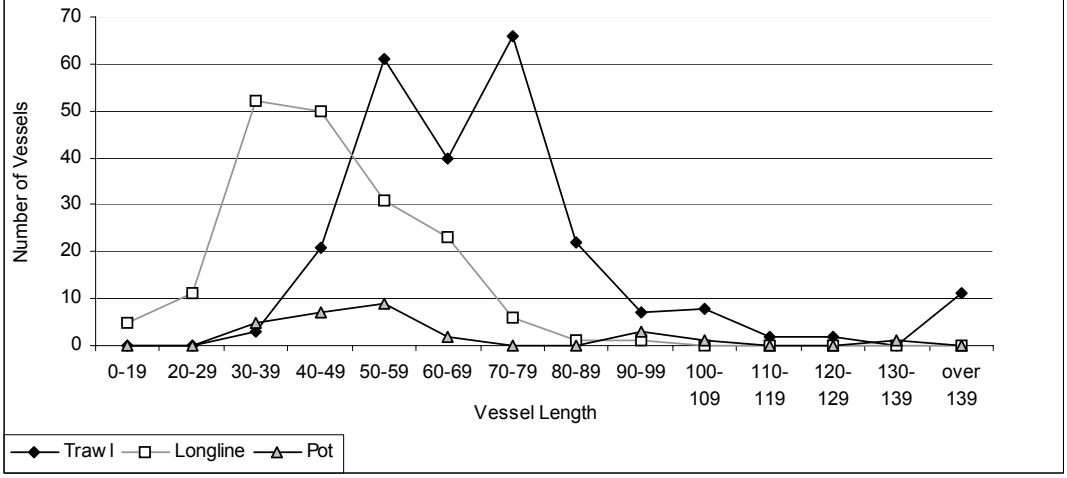

Figure 3.3.2



### 3.3.2 Profile of the Commercial Limited Entry (Non-Tribal) Groundfish Fisheries

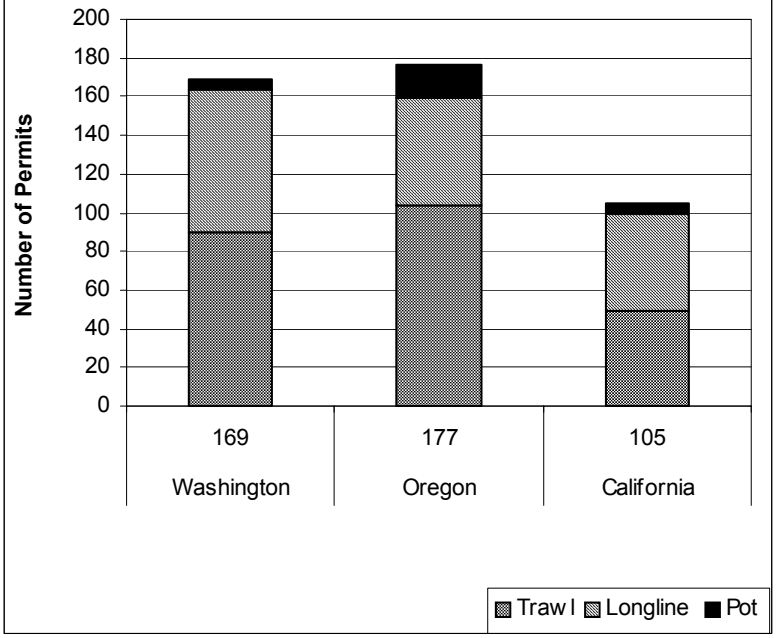
The Pacific coast groundfish fishery is a year-round, multi-species fishery that takes place off the coasts of Washington, Oregon, and California. Most of the Pacific coast non-tribal, commercial groundfish harvest is taken by the limited entry fleet. The groundfish limited entry program was established in 1994 for trawl, longline, and trap (or pot) gears. There are also several open access fisheries that take groundfish incidentally or in small amounts; participants in those fisheries may use, but are not limited to longline, vertical hook-and-line, troll, pot, setnet, trammel net, shrimp and prawn trawl, California halibut trawl, and sea cucumber trawl. Open access fisheries are described below at Section 3.3.3. In addition to these non-tribal commercial fisheries, members of the Makah, Quileute, Hoh, and Quinault tribes participate in commercial, and ceremonial and subsistence fisheries for groundfish off the Washington coast. Tribal groundfish fisheries are described below at Section 3.3.4.

Figure 3.3.3 Limited Entry Vessel Lengths, By Gear Type




In 1994, NMFS implemented Amendment 6 to the FMP, a license limitation program intended to restrict vessel participation in the directed commercial groundfish fisheries off Washington, Oregon, and California. The limited entry permits that were created through that program specify the gear type that a permitted vessel may use to participate in the limited entry fishery, and the vessel length associated with the permit. A vessel may only participate in the fishery with the gear designated on its permit(s) and may only be registered to a permit appropriate to the vessel's length. Since 1994, the Council has created further license restrictions for the limited entry fixed gear (longline and fishpot gear) fleet that restrict the number of permits useable in the primary sablefish fishery (Amendment 9) and that allow up to three

**Figure 3.3.4 Limited Entry Permits, by State and Gear**

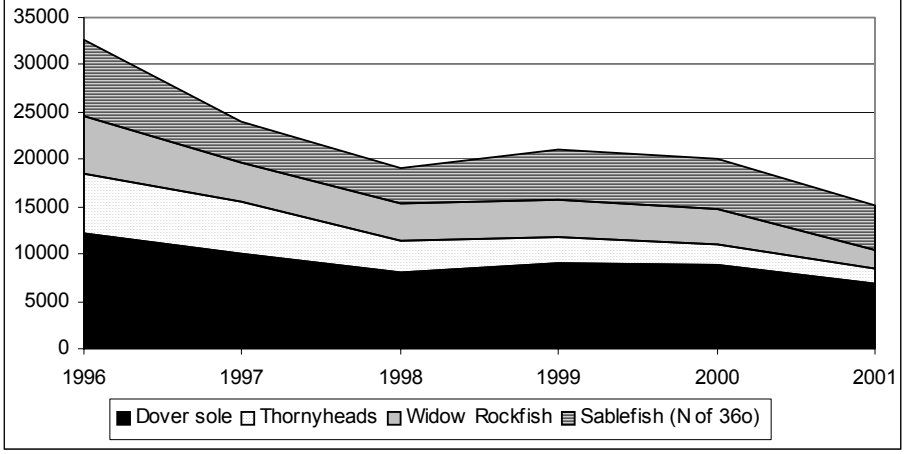


sablefish-endorsed permits to be used per vessel (Amendment 14.)

As of March, 2002, there were 450 vessels with Pacific Coast groundfish limited entry permits, of which approximately 54 percent were trawl vessels, 40 percent were longline vessels, and 6 percent were trap vessels. The number of vessels registered for use with limited entry permits has decreased since the 2001 implementation of the permit stacking program for sablefish-endorsed limited entry fixed gear permits. Of the approximately 164 sablefish-endorsed permits, 83 are held by vessels registered with more than one sablefish-endorsed permit. Of the vessels that are registered with multiple sablefish-endorsed permits, 25 are registered with two permits and 11 are registered with three permits.

Limited entry permits may be sold and leased out by their owners, so the distribution of permits between the three states often shifts. In 2002, roughly 23 percent of the limited entry permits were assigned to vessels making landings in California, 39 percent to vessels making landings in Oregon, and 37 percent to vessels making landings in Washington. In 1999, this division of permits was approximately 41 percent for California, 37 percent for Oregon, and 21 percent for Washington. This change in state distribution of limited entry permits may be due to the implementation of the permit stacking program. Vessels operating from northern ports may have purchased or leased sablefish-endorsed permits from vessels that had been operating out of California ports.

**Figure 3.3.5 Groundfish Landings (Selected Species) 1996-2001, in metric tons**




Limited entry fishers focus their efforts on many different species, with the largest landings by volume (other than Pacific whiting) from the following species: Dover sole, arrowtooth flounder, petrale sole, sablefish, thornyheads, and yellowtail rockfish. There are 55+ rockfish species managed by the Pacific coast groundfish FMP, of which seven species have been declared overfished in the past four years. Protective fisheries regulations intended to reduce the directed and incidental catch of overfished rockfish and other depleted species have notably reduced the harvest of rockfish in recent years, described at Table 3.3.2.

By weight, Pacific whiting represents the vast majority of West Coast groundfish landings. The whiting mid-water trawl fishery is a distinct component from the trawl groundfish trip limit fisheries. In 2001, whiting accounted for about 85 percent, by weight, of all commercial shore-based groundfish landings. Whiting is taken by treaty tribe catcher vessels delivering to a mothership (17.5% of total OY in 2002,) by non-tribal catcher vessels delivering to shore-based processing plants (42% of non-tribal OY,) by non-tribal catcher-vessels delivering to motherships (24% of non-tribal OY,) and by non-tribal catcher-processor vessels (34% of the non-tribal OY.) In 2001, 29 catcher vessels delivered whiting to shore-based processing plants. This number is down from previous years, when the number of participating vessels was in the mid- to upper-30s. Some vessels move between the West Coast and Alaska fisheries; some remain entirely off Washington, Oregon, and California. In 2001, the majority of whiting (about 73%) was landed in Oregon; Washington landings represented 24% of the total and California landings represented about 3.1%. Approximately 20 catcher vessels delivered to five motherships in 2001, and seven catcher-processor vessels participated in the whiting fishery. Also in 2001, four tribal catcher vessels delivered whiting to one mothership.

**Figure 3.3.6a Groundfish Trawl Vessel Participation in Non-Groundfish Fisheries**

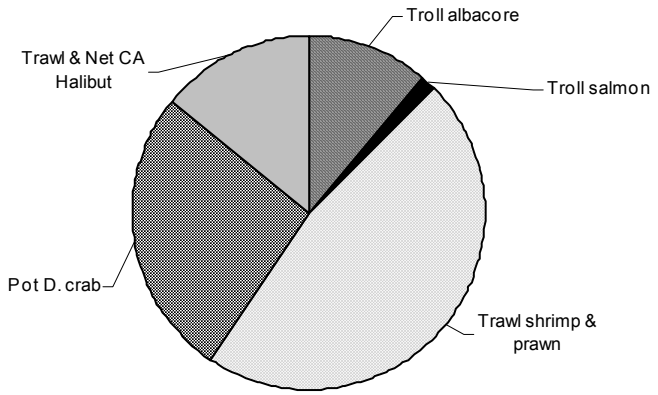



**Figure 3.3.6b Groundfish Hook-and-Line (Includes Open Access) Vessel Participation in Non-Groundfish Fisheries**

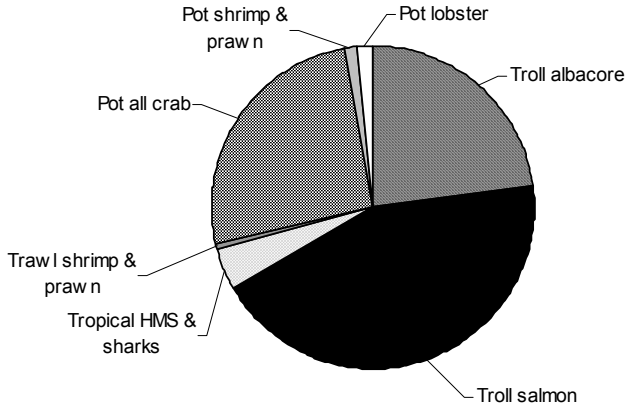
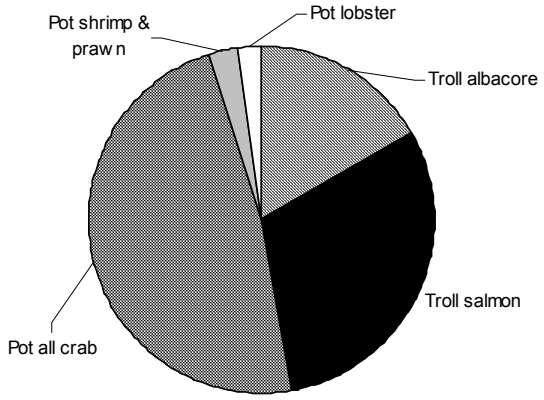



**Figure 3.3.6c Groundfish Pot (Including Open Access) Vessel Participation in Non-Groundfish Fisheries**




Catcher vessel owners and captains employ a variety of strategies to fill out a year of fishing. Fishers from the northern ports may fish in waters off of Alaska, as well as in the West Coast groundfish fishery. Others may change their operations throughout the year, targeting salmon, shrimp, crab, or albacore, in addition to various groundfish species, so as to spend more time in waters close to their communities. Factory trawlers and motherships fishing for or processing Pacific whiting off of the West Coast usually also participate in the Alaska pollock seasons, allowing the vessels and crews to spend a greater percentage of the year at work on the ocean. Commercial fisheries landings for species other than groundfish vary along the length of the coast. Dungeness crab landings are particularly high in Washington state, squid, anchovies, and other coastal pelagics figure heavily in California commercial landings, with salmon, shrimp, and highly migratory species like albacore more widely distributed, and varying from year to year.

Figures 3.3.6a-c show the approximate concentration of groundfish vessels in fisheries for non-groundfish West Coast species, 1994-1998. These pie charts exclude some non-groundfish fisheries where participation by groundfish vessels was so minimal that a viewer could not reasonably see the corresponding portion of the pie chart. Data for these charts came from an ongoing Council staff project to create a socio-economic profile of groundfish fishery participants.

It is clear from these three charts that there is some degree of gear loyalty for groundfish vessels participating in non-groundfish fisheries. For example, a notable proportion of the non-groundfish fishery participation by groundfish trawl vessels occurs in the shrimp and prawn trawl fisheries. Similarly, the hook-and-line groundfish fisheries show high participation in the troll albacore and troll salmon fisheries. And, while all three gear groups participate in pot fisheries for crab, groundfish pot vessels show the greatest percentage of gear group participation in pot fisheries for crab and other crustaceans.

### 3.3.3 Profile of the Commercial Open Access (Non-Tribal) Groundfish Fisheries, Directed and Incidental

Unlike the limited entry sector, the open access fishery has unrestricted participation and is comprised of vessels targeting or incidentally catching groundfish with a variety of gears, excluding groundfish trawl gear. While the open access groundfish fishery is under federal management and does not have participation restrictions, some state and federally managed fisheries that land groundfish in the open access fishery have implemented their own limited entry (restricted access) fisheries or enacted management provisions that have affected participation in groundfish fisheries.

The commercial open access groundfish fishery consists of vessels that do not necessarily depend on revenue from the fishery as a major source of income. Many vessels that predominately fish for other species inadvertently catch and land groundfish. Or, in times and areas when fisheries for other species are not profitable, some vessels will transition into the groundfish open access fishery for short periods. The commercial open access fishery for groundfish is split between vessels targeting groundfish (*directed fishery*) and vessels targeting other species (*incidental fishery*). The number of unique vessels targeting groundfish in the open access fishery between 1995-1998 coastwide was 2,723, while 2,024 unique vessels landed groundfish as incidental catch (1,231 of these vessels participated in both) (SSC's Economic Subcommittee, 2000).

In the directed open access fishery, fishers target groundfish in the "dead" and/or "live" fish fishery using a variety of gears. The terms dead and live fish fisheries refers to the state of the fish when they are landed. The dead fish fishery has historically been the most common way to land fish. The dead fish fishery made up 80% of the directed open access landings by weight coastwide in 2001. More recently, the market value for live fish has increased landings of live groundfish. The other component of the open access fishery is the incidental catch of groundfish in fisheries targeting other species (e.g., shrimp, salmon, highly migratory species, squid). Combining both the directed and incidental fisheries, the commercial groundfish open access fishery is potentially very large and includes a variety of gear types.

**Landings, Revenue, and Participation by State** Fisheries are generally distributed along the coast in patterns governed by factors such as location of target species, location of ports with supporting marine supplies and services, and restrictions/regulations of various state and federal governments. For the open access directed groundfish fishery, the majority of landings by weight that target groundfish occur off California. Oregon's directed groundfish open access fishery has the next highest landings, followed by Washington's. In the incidental groundfish fisheries, Oregon and California both have similar landings in their open access fisheries. Washington again has the lowest landings by weight of incidental groundfish (PFMC 2001e). Participation in "both directed and bycatch components of the open access fishery is much greater in California than in Oregon and Washington combined. For instance, in 1998, 779 California boats, 232 Oregon boats and 50 Washington boats participated in the directed fishery. In that same year, 520 California boats, 305 Oregon boats and 40 Washington boats participated in the bycatch fishery" (SSC's Economic Subcommittee, 2000).

Open access fisheries have been examined for their landings in the years 1996 and 2001, two randomly chosen years following the implementation of the limited entry program. Overall and in each individual state, open access landings decreased between 1996 and 2001. Federally, open access landings limits were sharply reduced between 1996 and 2001. Ex-vessel value for open access groundfish fisheries also decreased coastwide between 1996 and 2001. The directed fishery decreased from over $7 million in 1996 to under $5 million in 2001 and the incidental fishery decreased by half, from roughly $800,000 in 1996 to roughly $400,000 in 2001. (Goen & Hastie 2002)

| *Table 3.3.3: Estimated Open Access Fishery Landings in 1996 and 2001, by state, weight and value* | | |
|---|---|---|
| *Open Access Sector* | *1996 landings by weight* | *2001 landings by weight* |
| Coastwide Directed | 3,291 mt | 1,086 mt |
| Coastwide Incidental | 802 mt | 197 mt |
| Washington Directed | 225 mt | 66 mt |
| Washington Incidental | 296 mt | 28 mt |
| Oregon Directed | 458 mt | 237 mt |
| Oregon Incidental | 384 mt | 98 mt |
| California Directed | 2,608 mt | 776 mt |
| California Incidental | 122 mt | 70 mt |

**Directed Fishery** The directed open access fishery for groundfish primarily targets rockfish, sablefish, lingcod, cabezon and flatfish. A vessel is considered to target groundfish in the open access fishery during a fishing trip if it is fishing with any gear other than groundfish trawl and if over 50% of the revenue from landings in that trip were from groundfish species. Participation in the directed fishery has decreased from 1,357 vessels in 1994 to 1,032 in 1999 (PFMC 2001). Reasons for this trend could include movement from the groundfish open access sector into other more profitable fisheries, or movement out of fishing all together.

As previously mentioned, the open access directed groundfish fishery consists of landings in both the dead and live fish categories. In the directed fishery, gears used to target and land dead groundfish include: vertical hook and line, rod/reel, pot, longline, troll/dinglebar, jig, sculpin trawl, setnet, and drifted (fly gear). Essentially all of the groundfish species managed under the FMP are targeted by various gears in the directed open access dead fishery. Increasingly, the live fish trade is gaining landings, due to a growing market value for live fish. In 2001, the live fish directed open access fishery accounted for 20% of the coastwide directed open access landings by weight, compared to only 6% in 1996. Gear used to target live groundfish include: pot, stick, and rod/reel. While Washington has prohibited live fish landings since 1999, both Oregon and California have live fish fisheries targeting groundfish. Currently, Oregon and California are drafting nearshore fishery management plans (FMPs) that could transition some species of groundfish landed in the live fish fishery from federal to state management.

In the directed open access fishery, certain gears are used to target specific species. Hook-and-line gear, the most common gear type, is generally used to target sablefish, rockfish and lingcod, while pot gear generally targets sablefish and some thornyheads and rockfish. In southern and central California, setnet gear targets rockfish, including chilipepper, widow, bocaccio, yellowtail and olive rockfish, and to a lesser extent vermillion rockfish.

**Incidental Fisheries** Fisheries that catch and land groundfish incidentally include: pink shrimp, spot prawn, ridgeback prawn, California and Pacific halibut, Dungeness crab, salmon, sea cucumber, coastal pelagic species, California sheephead, highly migratory species and the gillnet complex. Some of the gears in the incidental groundfish fishery include: non-groundfish trawl, pot, pole/line, longline, round haul, setnet, driftnet, purse seine, harpoon, gillnet, and troll. Not all of these fisheries have notable incidental groundfish catch. Open access fisheries with greater incidental groundfish catch are reviewed herein. For further information see Goen & Hastie, 2002, “Pacific Coast Groundfish Open Access Fishery Report, available from the Council.

**Pink Shrimp** Pink shrimp, also known as ocean shrimp, range from the Aleutian Islands in Alaska to San Diego, California, at depths from 150 to 1200 feet. They are targeted with shrimp trawl gear off

Washington, Oregon, and California. The pink shrimp fishery is managed by the states, with incidental catch limits imposed as trip limits in the federal open access groundfish fishery under "exempted trawl." Vessels targeting pink shrimp also land groundfish species, including rockfish, lingcod, sablefish, thornyheads, and flatfish. Between 1990 and 2001, coastwide landings of groundfish in the pink shrimp fishery reached a high in 1993 of 896 metric tons, 8 % of the total landing with shrimp (Goen & Hastie 2002). Many groundfish species are caught incidentally in the pink shrimp fishery due in part to the indiscriminate nature of trawl gear. Efforts are underway to reduce the incidence of groundfish bycatch, by requiring bycatch reduction devices (BRDs) and no-fishing buffer zones above the seafloor. In 2001, Washington and Oregon instituted mandatory BRDs in pink shrimp trawl nets, effective August 1, 2001, to reduce finfish take, including canary rockfish, an overfished species. Historically, about 71% of the canary rockfish landed annually by Pacific Coast shrimpers was landed in Oregon (ODFW 2002). As of 2003, all three states are requiring their pink shrimp trawlers to use BRDs to protect overfished groundfish species.

In Washington, 15 vessels participated in the pink shrimp fishery in 1998 and 14 on a regular basis in 1999. In Oregon, only 84 vessels landed shrimp in 2001 (74 double-rig; 10 single-rig) compared to 108 in 2000, 121 in 1999 and 109 vessels in 1998 (ODFW 2002, PSMFC 1997). Despite lower landings in recent years, Oregon generally has the largest volume by weight of landings. In 1999, Oregon landed more pink shrimp than California, Washington, British Columbia and Alaska combined. In California, an average of 88 vessels participated per season from 1983 through 1999 (Collier and Hannah 2001).

**Pacific Halibut** Pacific halibut range from the Hokkaido, Japan to the Gulf of Anadyr, Russia on the Asiatic Coast and from Nome, Alaska to Santa Barbara, California on the North American (Pacific) Coast. The Pacific halibut fishery is managed by the International Pacific Halibut Commission (IPHC) with implementing regulations set by the federal governments of Canada and the United States in their respective waters. A license from the IPHC is required to participate in the non-treaty commercial Pacific halibut fishery. The commercial sector off the Pacific Coast, IPHC Area 2A, has both a treaty and non-treaty sector. For the non-treaty commercial sector, harvest is divided between the directed halibut fishery and the incidental catch of halibut in the salmon troll fishery. When the Area 2A total allowable catch is above 900,000 lbs, as it has been in recent years, halibut may be retained in the limited entry primary sablefish fishery north of Point Chehalis, Washington (46˚53'18" N. lat.).

The non-treaty directed commercial fishery in Area 2A is confined to south of Point Chehalis, Washington, Oregon, and California. Area 2A licenses, issued for the directed commercial fishery, have decreased from 428 in 1997 to 320 in 2001. For 2001, the directed commercial licenses also allow longline vessels to retain halibut caught incidentally north of Point Chehalis during the primary sablefish season. Area 2A licenses issued for the incidental salmon troll fishery increased from 275 in 1997 to 345 in 2001. In Area 2A, the incidental salmon troll fishery was allowed to retain 1 halibut per 5 chinook, plus 1 extra halibut, with a maximum of 35 incidental halibut landed. Groundfish are caught in the Pacific halibut fishery coastwide. Rockfish and sablefish are commonly intercepted, as they are found in similar habitat to Pacific halibut and are easily caught with longline gear. The recent overfished species designation of yelloweye rockfish, which is commonly caught with Pacific halibut, led the Council to recommend area restrictions for both recreational and commercial halibut fisheries in 2003. NMFS is reviewing these recommendations for potential implementation by March 1, 2003, prior to the start of the 2003 Pacific halibut season.

**Salmon** Salmon are targeted with troll gear off all three West Coast states. The ocean commercial salmon fishery, both non-treaty and treaty, is under federal management with a suite of seasons and total allowable harvest. The Council manages commercial fisheries in the Exclusive Economic Zone (3-200 miles offshore), while the states manage commercial fisheries in state waters (0-3 miles). Beside troll gear, salmon are also targeted with gillnets and/or tanglenets in the mouths of rivers. Although the gillnet/tanglenet fishery does not technically occur in Council-managed waters, it may have some effect on groundfish that migrate through that area during part of their life cycle.

The majority of chinook and coho were landed in California in 1999 with Washington and Oregon both

having notably fewer landings. The salmon troll fishery does have an incidental catch of Pacific halibut and groundfish, including yellowtail rockfish. Halibut are caught incidentally off Washington and Oregon, while groundfish are caught off all three states. The California salmon fisheries primarily harvest chinook or king salmon. Coho or silver salmon are observed in small numbers but are presently under a no-retention catch policy. Occasionally in odd-numbered years, pink salmon are landed. In 1983, California implemented a limited entry program that capped the fishery at just over 4,600 commercial salmon vessels. Rockfish species taken with hook-and-line gear are susceptible to salmon troll gear. Yellowtail rockfish in particular have often bee landed with troll-caught salmon.

**Gillnet Complex** The gillnet or driftnet complex is managed by the state of California and made up of California halibut, white seabass, white croaker and sharks. These species are targeted solely with driftnet gear off California, since the setnet fishery for white seabass was prohibited in 1994. White seabass may also be caught with commercial hook-and-line gear in the early spring, when large seabass are available. White croaker, an abundant nearshore species, is predominately caught off central California in the driftnet fishery, although they range from Vancouver Island, British Columbia to Magdalena Bay, Baja California (but are not abundant north of Point Reyes, California). The entrance of Southeast Asian refugees (mainly Vietnamese) into this fishery, in part caused a shift in fishing effort from southern to central California (Moore and Wild 2001, p.234).

### 3.3.4 Profile of the Tribal Groundfish Fisheries, Directed and Incidental

In 1994, the U.S. government formally recognized that the four Washington Coastal Tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish, and concluded that, in general terms, the quantification of those rights is 50 percent of the harvestable surplus of groundfish available in the tribes' usual and accustomed (U and A) fishing areas (described at 60 CFR 660.324). West Coast treaty tribes have formal allocations for sablefish, black rockfish, and Pacific whiting. Members of the four coastal treaty tribes participate in commercial, ceremonial, and subsistence fisheries for groundfish off the Washington coast. Participants in the tribal commercial fisheries operate off Washington and use similar gear to non-tribal fishers. Groundfish caught in the tribal commercial fishery pass through the same markets as non-tribal commercial groundfish catch.

In 2002, tribal sablefish longline fisheries were allocated 10% of the total catch OY (436.7 mt) and then were discounted 3% of that allocation for discard mortality, for a landed catch allocation of 424 mt. For the commercial harvest of black rockfish off Washington State, the treaty tribes have a harvest guideline of: 20,000 lb (9,072 kg) north of Cape Alava (48°09'30" N. lat.) and 10,000 lb (4,536 kg) between Destruction Island (47°40'00" N. lat.) and Leadbetter Point (46°38'10" N. lat.). In 1999 and 2000 32,500 mt of whiting was set aside for treaty Indian tribes on the coast of Washington state, resulting in a commercial OY of 199,500 mt for 2000. In 2001 and 2002 the landed catch OY declined to 190,400 mt and 129,600 mt, respectively, and the tribal allocations for those years were also reduced to 27,500 mt and 22,680 mt, respectively.

There are several groundfish species taken in tribal fisheries for which the tribes have no formal allocations. For some species on which the tribes have a modest harvest, no specific allocation has been determined. Rather than try to reserve specific allocations of these species, the tribes annually recommend trip limits for these species to the Council that accommodate modest tribal fisheries. Tribal trip limits for groundfish species without tribal allocations are usually intended to constrain direct catch and incidental retention of overfished species in the tribal groundfish fisheries.

The bulk of tribal groundfish landings occur during the March-April halibut and sablefish fisheries. Most continental shelf species taken in the tribal groundfish fisheries are taken during the halibut fisheries and most slope species are similarly taken during the tribal sablefish fisheries. Approximately one-third of the tribal sablefish allocation is taken during an open competition fishery, in which member vessels from the sablefish tribes all have access to this portion of the overall tribal sablefish allocation. The open competition portion tends to be taken during the same period as the major tribal commercial halibut

fisheries in March and April. The remaining two-thirds of the tribal sablefish allocation are split between the sablefish tribes according to a mutually agreed-upon allocation scheme. Tribe-specific sablefish allocations are managed by the individual sablefish tribes, beginning in March and lasting into the autumn, depending on vessel participation management measures used. Participants in the halibut and sablefish fisheries tend to use hook-and-line gear, as required by the International Pacific Halibut Commission.

In addition to these hook-and-line fisheries, the Makah tribe annually harvests a whiting allocation using mid-water trawl gear. Since 1996, a portion of the U.S. whiting OY has been allocated to the Pacific Coast treaty tribes. The tribal allocation is subtracted from the whiting OY before allocation to the nontribal sectors. Since 1999, the tribal allocation has been based on a framework that is a sliding scale related to the U.S. whiting OY. To date, only the Makah tribe has fished on the tribal whiting allocation.

| **Table 3.3.4 Tribal Framework for Whiting Allocation, Adopted in 1999** | |
|---|---|
| U.S. Optimum Yield | Tribal Allocation |
| Up to 145,000 mt | 17.5% of the U.S. OY |
| 145,001 mt to 175,000 mt | 25,000 mt |
| 175,001 mt to 200,000 mt | 27,500 mt |
| 200,001 mt to 225,000 mt | 30,000 mt |
| 225,001 mt to 250,000 mt | 32,500 mt |
| Over 250,000 mt | 35,000 mt |

Makah vessels fit with mid-water trawl gear have also been targeting widow and yellowtail rockfish with mid-water gear in recent years.

**Table 3.3.5 Treaty Tribe Groundfish Landings, 1995-2001. In pounds, except for whiting, which is in mt.**

| *Species* | *1995* | *1996* | *1997* | *1998* | *1999* | *2000* | *2001* |
|---|---|---|---|---|---|---|---|
| *Lingcod* | 2,162 | 1,616 | 1,555 | 3,477 | 4,086 | 4,054 | 6,757 |
| *Rockfish (general)* | 110,673 | 38,105 | 48,969 | 54,638 | 41,379 | 32,827 | 131 |
| *Rockfish (red)* | 211 | 137 | 87 | 619 | 1,067 | 431 | 2,141 |
| *Widow Rockfish* | | | | | 73 | 2,012 | 8,445 |
| *Yellowtail Rockfish* | 734 | 1,087 | 2,528 | 10,370 | 29,281 | 71,124 | 150,254 |
| *Shortspine thornyhead* | 15,476 | 7,408 | 12,483 | 4,916 | 7,984 | 8,705 | 11,008 |
| *Sablefish* | 1,177,704 | 1,128,795 | 1,078,875 | 634,512 | 812,511 | 958,490 | 907,399 |
| *Whiting (in metric tons)* | | 15,000 | 24,840 | 24,509 | 25,844 | 6,251 | 6,080 |

Twelve western Washington tribes possess and exercise treaty fishing rights to halibut, including the four tribes that possess treaty fishing rights to groundfish. Specific halibut allocations for the treaty Indian tribes began in 1986. The tribes did not harvest their full allocation until 1989, when the tribal fleet had developed to the point that it could harvest the entire Area 2A TAC. In 1993, judicial confirmation of treaty halibut rights occurred and treaty entitlement was established at 50 percent of the harvestable surplus of

halibut in the tribes' combined U&A fishing grounds. In 2000, the courts ordered an adjustment to the halibut allocation for 2000-2007, to account for reductions in the tribal halibut allocation from 1989-1993. For 2000 through 2007, the non-tribal fisheries will be transferring at least 25,000 lb per year to the tribal fisheries, for a total of 200,000 lb to be transferred to the tribal fisheries over that period. Tribal allocations are divided into a tribal commercial component and the year-round ceremonial and subsistence (C&S) component.

Tribal commercial halibut fisheries start at the same time as Alaskan and Canadian commercial halibut fisheries, generally in mid-March. The tribal halibut allocation is divided so that approximately 80–85% of allocation is taken in brief open competition derbies, in which vessels from all halibut tribes compete against each other for landings. In 2002, three of these "unrestricted" openings were held in the spring: a 48-hour opening on March 18th, a 24-hour opening on April 2nd, and a 36-hour opening on April 30th. In addition to these unrestricted openings, 15-20% of the tribal halibut allocation is reserved for "restricted" fisheries, in which participating vessels are restricted to a per trip and per day poundage limit for halibut. Two restricted opening opportunities were available in 2002, from March 20th through April 19th and from May 5th through 9th. Similar to the unrestricted openings, these restricted openings are available for vessels from all halibut tribes.

**Table 3.3.6 Treaty Tribe Halibut Allocations and Catches, Dressed Weight, 1992-2001**

| Year | Commercial Allocation | Commercial Catch | C & S Allocation | C & S Catch |
|---|---|---|---|---|
| 1992 | 152,500 | 154,200 | 10,000 | 14,200 |
| 1993 | 136,000 | 136,200 | 14,000 | 15,800 |
| 1994 | 176,500 | 187,700 | 16,000 | 10,900 |
| 1995 | 171,000 | 176,400 | 11,000 | 14,200 |
| 1996 | 168,000 | 166,200 | 14,000 | 15,000 |
| 1997 | 230,000 | 228,500 | 15,000 | 14,800 |
| 1998 | 272,000 | 296,600 | 15,000 | 10,500 |
| 1999 | 256,000 | 271,500 | 10,000 | 10,500 |
| 2000 | 305,000 | 300,100 | 10,500 | 17,500 |
| 2001 | 406,500 | 411,600 | 17,500 | 16,000 |

### 3.3.5 Profile of the Recreational Fisheries

The recreational or sport fishery, where fishing is done for pleasure and not sale, has been part of the culture and economy of West Coast fishing communities for more than 50 years. Most recreational anglers use hook and line gear that is held directly in the hand or is attached to a pole or rod that is held in the hand. Recreational fishing occurs along the entire coast. Anglers fish from man-made structures such as piers, jetties, docks; natural shore areas; privately owned or rental boats; and charter vessels. Licenses for individual sport anglers are issued by the states of Washington, Oregon and California , with each state having its own specific requirements. Sport fishing licenses are issued to residents and non-residents and may vary in cost by the level of participation (ie: 1-day, 2-day, annual), fishery, and fishing location. In addition, there may be a few special days each year where anyone can fish without a fishing license. In California, anyone 16 years and older must have a fishing license to take any kind of marine fish, except for persons angling from a public pier in ocean or bay waters. Only a basic fishing license is required for fishing in the ocean north of Point Arguello (34° 35' N. Lat.) in Santa Barbara County, while an

Ocean Enhancement Stamp is required for ocean fishing south of Point Arguello (except when fishing under authority of a two-day sport fishing license.) One-day Pacific Ocean-only licenses, with or without an Ocean Enhancement Stamp are also issued. In Oregon, anyone 14 years or older is required to have a general angling license to fish for or land marine fish except when fishing for smelt or when they are a resident landowner or member of their immediate family and are angling on land they own and reside upon. In Oregon, all anglers, regardless of age, need a Combined Harvest Tag to fish for salmon, steelhead, sturgeon, and halibut. When angling in the Pacific ocean within 3 miles of shore between Cape Falcon, Oregon and Leadbetter point, Washington, either a resident Washington license or an Oregon license is valid. In Washington, a saltwater license is required for anyone who is 16 years or older and allows the license holder to fish for any species existing in saltwater, including salmon, steelhead, sturgeon, halibut, rockfish, etc.

In 1998, an economic survey funded by NMFS and coordinated with the PSMFC was conducted. Anglers were asked to participate in a telephone interview in addition to the interview conducted in the field. The following are some highlights from the survey:

1) 81% of the 37,570 anglers interviewed in California, Oregon and Washington provided trip information, including fishing expenditures.

2) Average year of birth for anglers was 1953.

3) Average rank of saltwater fishing ability on a scale of 1 to 5 was 3.2.

4) Average years of saltwater fishing experience was 20 years.

5) Average annual personal income before taxes was $57,000.

6) Average annual household income before taxes was $58,000.

7) Average hourly wage was $20.

8) Average hours worked per week was 45.

9) Average annual expenditure on fishing gear was $545.

10) Average annual expenditure on fishing licenses was $82.

11) Average annual expenditure on maintenance and repair of boats used for saltwater fishing was $640.

12) 20% of anglers stayed away from home overnight when they went fishing.

13) 64% of anglers whose fishing involved an overnight stay away from home indicated that the primary purpose of their trip was fishing

Similarly, the states register and issue licenses for recreational boats owned and operated by state residents. The registration requirements and fees vary between the states and are based on type and size of vessel. In California, every sail-powered vessel over 8 feet in length (except wind surfing boards) and every motor driven boat not registered by the U. S. Coast Guard that is used in California state waters is subject to registration. In Oregon, the Oregon State Marine Board is responsible for registering and titling all recreational boating vessels. Registration and title fees and marine fuel taxes support boating facilities, marine law enforcement and boating safety education. All motorized boats, regardless of length or type, must be registered and sailboats 12 feet or longer must also be registered in Oregon . In Washington state, motorized vessels and any vessel that is 16 feet or longer must be registered with the state.

Charter fishing as defined in section 2101(21a) of title 46, United States Code, is fishing from a vessel that is hired to carry passengers who engage in recreational fishing. In the Pacific coast groundfish fishery, there are two categories of charter vessels, party boats (also called “Six-Packs” for the number of passengers carried) and U.S.C.G. Certified passenger vessels (also called commercial passenger fishing vessels). The party boats are authorized by the U.S. Coast Guard to carry no more than six paying passengers. In general, these boats are smaller (although not necessarily small), are not required to pass rigorous Coast Guard inspection requirements and can be operated by skipper with a lower license rating. Commercial passenger fishing vessels are certified by the U.S. Coast Guard to carry a specific number of passengers. The vessels undergo a rigorous inspection every two years and must meet strict standards. Captains must also have a license to operate the vessel. In addition, if the certified boat is out for more than 12 hours, as in an over night trip, a second licensed captain must be on board. Table 3.3.4.1 shows the number of recreational charter vessels by port for 2001.

Within the recreational fishery, groundfish are both targeted and caught incidentally when other species such as salmon, are targeted. Until recent years, it was thought that commercial fisheries took the vast majority of marine fishery catch in the EEZ. However, recent data indicate that catches by the recreational fisheries are a notable portion of the total landings of some groundfish species. For some overfished species, such as lingcod, canary rockfish, bocaccio, and yelloweye rockfish, there are fairly large recreational catches. Table 3.3.8 shows the relationship of recreational and commercial total rockfish harvests, 1993-2001.

**Table 3.3.7 Number of Recreational Charter Vessels Fishing in Ocean Waters in 2001, by Port**

| State | Port/area | Number of Recreational Charter Vessels |
|---|---|---|
| **Washington** | Neah Bay | 15 |
| | La Push | 2 |
| | Westport | 32 |
| | Ilwaco | 28 |
| | TOTAL | 77 |
| **Oregon** | Astoria | 22 |
| | Tillamook | 51 |
| | Newport | 45 |
| | Coos Bay | 13 |
| | Brookings | 15 |
| | Unknown | 86 |
| | TOTAL | 232 |
| **California** | Crescent City | 1 |
| | Eureka | 4 |
| | Fort Bragg | 14 |
| | San Francisco | 67 |
| | Monterey | 33 |
| | Conception (north) | 129 |
| | San Diego | 95 |
| | Unknown | 72 |
| | TOTAL | 415 |
| | TOTAL FOR ALL STATES | 724 |

**Table 3.3.8 Landings of All Rockfish by Commercial and Recreational Sectors 1993- 2001 (PacFin/RecFin)**

| Year | Recreational (mt) | Commercial (mt) | Total | Percent Recreational |
|---|---|---|---|---|
| 1993 | 2,741 | 38,274 | 41,015 | 7% |
| 1994 | 2,378 | 31,656 | 34,034 | 7% |
| 1995 | 1,726 | 30,257 | 31,983 | 5% |
| 1996 | 2,141 | 28,919 | 31,060 | 7% |
| 1997 | 2,583 | 24,680 | 27,263 | 9% |
| 1998 | 2,325 | 20,867 | 23,192 | 10% |
| 1999 | 2,580 | 14,952 | 17,532 | 15% |
| 2000 | 2,578 | 13,358 | 15,936 | 16% |
| 2001 | 1,985 | 7,674 | 9,659 | 21% |

Data source: PacFin data were extracted November 25, 2002

Marine recreational fishing on the West Coast has been on an increasing trend since 1996 (PFMC 2002).

In 2001, 2.5 million marine recreational anglers took 5.2 million trips (1 million of these trips occurred in the federal EEZ) and are estimated to have caught 11,676 mt of fish of which 3,084 mt were groundfish. Most angling occurs during the summer months with fewer anglers fishing northward during the winter. Eighty eight percent of the trips in all ocean waters (state and federal waters) were made in California, followed by 9 percent in Washington, and 3 percent in Oregon. The number of participants has increased from 1.6 million in 1999 and 2.2 million in 2000. The number of trips has also increased from 3.1 million (0.64 million in the Federal EEZ) in 1999 and 4.6 million in 2000 (1.1 million in the Federal EEZ).

A portion of the increased recreational fishing effort is likely the result of longer salmon seasons that are associated with increased abundance and availability of salmon. Prior to 1996 when salmon seasons were shortened to protect declining populations, target effort shifts from recreational salmon fishing to groundfish targeting likely occurred. It is uncertain how much groundfish catch contributes to the overall incentive to engage in a recreational fishing. However, it seems likely that the frequency of groundfish catch on a trip adds to overall enjoyment and perceived value. Tables 3.3.9 - 3.3.11 identify the number of participants, fishing trips, and catch by fishing mode for 2001.

In southern California, most angling effort takes place from private/rental boats (43% of all ocean and trips or 49% of trips into the EEZ) and from charter vessels (27% of all ocean and trips or 51% of trips into the EEZ). Approximately 13 percent of the charter vessels take spear fishing divers. The recreational fishery in southern California targets a variety of species including: shelf and nearshore rockfishes (including California scorpionfish); lingcod; cabezon; California barracuda; yellowtail; ocean whitefish; tuna (including yellowfin and albacore); flatfish (including California halibut and sanddabs); kelp bass; barred sand bass, and spotted sandbass; white sea bass and California sheephead. Salmon are infrequently taken in southern California. Shelf rockfish, lingcod, California barracuda, yellowtail, ocean whitefish, and tunas are primarily taken by anglers aboard private/rental and charter vessels. The other species are taken by anglers from all modes. Divers primarily take nearshore rockfishes, lingcod, California sheephead, and Kelp bass.

In northern California, most of recreational angling effort takes place from private/rental boats and from shore (46% of all ocean trips or 61% of trips into the EEZ). Spear fishing represents a very small amount of the effort with less than 2 percent of the charter vessels catering to divers. The recreational fishery in northern California primarily targets shelf and nearshore rockfishes, lingcod and salmon. In addition, cabezon, greenling, albacore, and flatfish (including sanddabs and California halibut) may be targeted. Shelf rockfish, lingcod, salmon, and albacore are primarily taken by charter vessels and private/rental boats. Greenling are primarily taken by private /rental boats and shore anglers. Other species are taken by anglers from all modes.

In Oregon, most recreational angling effort takes place from private/rental boats (62% of all ocean and trips or 67% of trips into the EEZ). The recreational fishery in Oregon primarily targets shelf and nearshore rockfishes, lingcod, greenling, Pacific halibut, salmon, cabezon, and albacore. Salmon and nearshore species such as greenling and cabezon are primarily taken by private/rental vessels, while the remaining species are more equally divided between the charter and private/rental boats.

In Washington, most recreational angling effort takes place from private/rental vessels (57% of all ocean trips or 58% of trips into the EEZ). The recreational fishery in Washington primarily targets shelf, and nearshore rockfishes, lingcod, greenling, Pacific halibut, salmon, sablefish, and albacore. Nearshore rockfish is primarily taken by charter vessels, while catch of the other species are more closely divided between the charter and private/rental boats.

**Table 3.3.9 Estimated Number of Anglers in Ocean Fisheries 2001, by Fishing Mode, Thousands of Anglers** (MRFSS)

| | Coastal Residents | Non-coastal Residents | Out-of state Residents | Total |
|---|---|---|---|---|
| **Southern California** | 1,054 | 15 | 185 | 1,255 |
| **Northern California** | 454 | 72 | 63 | 589 |
| **Oregon** | 312 | 30 | 84 | 426 |
| **Washington** | 571 | 36 | 49 | 655 |

| | | | | |
|---|---|---|---|---|
| **Coastwide** | 2,390 | 154 | n/a | 2,544 |

**Table 3.3.10 Estimated Number of Fishing Trips in Ocean Waters 2001 by Fishing Mode, Millions of Trips (EEZ only)** (MRFSS)

| | Party/charter Vessel | Private/Rental Vessel | Shore | Total |
|---|---|---|---|---|
| **Southern California** | 0.99 (0.32) | 1.39 (0.31) | 0.86 | 3.24 (0.63) |
| **Northern California** | 0.26 (0.09) | 0.62 (0.14) | 0.46 | 1.34 (0.23) |
| **Oregon** | 0.10 (0.02) | 0.31 (0.04) | 0.09 | 0.50 (0.06) |
| **Washington** | 0.05 (0.05) | 0.08 (0.07) | 0.01 | 0.14 (0.12) |
| **Total** | 1.40 (0.47) | 2.41 (0.56) | 1.41 | 5.22 (1.03) |

**Table 3.3.11 Estimated Recreational Groundfish Catch in Ocean Waters 2001 by Fishing Mode, Metric Tons**

| | Party/charter Vessel | Private/Rental Vessel | Total |
|---|---|---|---|
| **Southern California** | 165 | 252 | 419 |
| **Northern California** | 728 | 945 | 1,675 |
| **Oregon** | 370 | 387 | 759 |
| **Washington** | 182 | 48 | 231 |
| **Total** | 1,445 | 1,632 | 3,084 |

Regulatory management measures available to manage the West Coast recreational groundfish catch include, but are not limited to, harvest guidelines, quotas, landing limits, frequency limits, gear restrictions, time/area closures, bag and size limits, permits, other forms of effort control. For 2003, recreational fisheries effort will be constrained to protect overfished species, particularly for lingcod, canary rockfish, bocaccio, and yelloweye rockfish. Washington, Oregon, and California will adopt through state regulation seasons, bag limits, and size limits to best fit the needs of their recreational fisheries in their states while also meeting conservation goals of the FMP.

For 2003, recreational fisheries management off Washington and Oregon have been structured to maintain low yelloweye rockfish catch, an overfished species primarily taken with hook and line gear. In reviewing the take of yelloweye rockfish in their recreational fisheries, the states of Washington and Oregon found that yelloweye rockfish is most frequently taken by vessels that travel offshore to target Pacific halibut. However, yelloweye rockfish are not taken while the vessel is fishing for halibut, but rather after the vessel has completed its halibut fishing and is headed for port. Recreational fishing restrictions proposed by California are intended to ensure that fishing mortality of bocaccio, canary rockfish, cowcod, and lingcod do not exceed limits associated with rebuilding these overfished species. Because California's recreational fisheries management measures were not sufficiently conservative to prevent their fisheries from exceeding their set asides for overfished rockfish species in 2001 and 2002, more restrictive measures will be used for 2003. Management measures adopted for 2003 are fully described in the proposed rule for 2003 Annual Specifications and Management Measures (January 7, 2003; FR 936.)

In addition to the leisure benefits that recreational anglers receive from participating in marine fisheries, they generate monetary benefits in the form of sales, income, and employment throughout the Pacific Coast region. A wide variety of goods and services are purchased by anglers from sporting goods stores,

speciality stores, bait and tackle shops, guide services, marinas, grocery stores, automobile service stations, and restaurants. The economic impacts of these purchases occur throughout the Pacific Coast economy and provide income and jobs in manufacturing, transportation industries, and service sectors. Across Washington, Oregon, and California, it is estimated that recreational anglers spent $4.5 billion on marine recreational fishing in 2000, with Southern California anglers spending the most ($2.5 billion). Nationwide, recreational fishing expenditures total $21 billion (Gentner et al. 2001). The recreational fishery in Washington, Oregon, and California are associated with $254 Million in personal income and almost 10,000 jobs; the groundfish fishery represented $71 Million and 2,800 jobs, respectively or about 28% of the total (Table 3.3.13.).

**Table 3.3.12 Recreational Fishery Harvest by Region for Party/charter Boats and Private/rental Boats, 2001, in Metric Tons** (RecFin)

| | Lingcod | Nearshore Rockfish | Shelf Rockfish | Other Nearshore Groundfish | Other Shelf Groundfish | Other Groundfish | Total Groundfish | Salmon | Halibut | Highly Migratory Species | Other | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Washington** | | | | | | | | | | | | |
| **Charter** | 17 | 153 | 11 | 1 | 0 | 0 | 182 | 33 | 105 | 0 | 0 | 320 |
| **Private** | 15 | 20 | 10 | 3 | 0 | 0 | 48 | 38 | 103 | 0 | 0 | 189 |
| **Total** | 32 | 175 | 21 | 3 | 0 | 0 | 231 | 70 | 208 | 0 | 0 | 509 |
| **Oregon** | | | | | | | | | | | | |
| **Charter** | 53 | 274 | 33 | 10 | 0 | 0 | 370 | 91 | 21 | 0 | 7 | 489 |
| **Private** | 60 | 282 | 12 | 33 | 0 | 0 | 387 | 1,108 | 3 | 11 | 176 | 1,685 |
| **Total** | 114 | 557 | 46 | 42 | 0 | 0 | 759 | 1,199 | 24 | 11 | 183 | 2,176 |
| **Northern California** | | | | | | | | | | | | |
| **Charter** | 41 | 351 | 316 | 20 | 0 | 0 | 728 | 187 | 0 | 80 | 53 | 1,048 |
| **Private** | 90 | 290 | 111 | 439 | 15 | 0 | 945 | 1,384 | 0 | 387 | 1,048 | 3,764 |
| **Total** | 131 | 642 | 426 | 460 | 16 | 0 | 1,675 | 1,572 | 0 | 467 | 1,100 | 4,814 |
| **Southern California** | | | | | | | | | | | | |
| **Charter** | 4 | 26 | 73 | 47 | 14 | 1 | 165 | 0 | 0 | 348 | 1,088 | 1,601 |
| **Private** | 19 | 15 | 112 | 78 | 26 | 2 | 252 | 0 | 0 | 411 | 1,907 | 2,570 |
| **Total** | 23 | 41 | 186 | 125 | 41 | 3 | 419 | 0 | 0 | 759 | 2,999 | 4,177 |
| **Coastwide** | | | | | | | | | | | | |
| **Charter** | 115 | 804 | 433 | 78 | 14 | 1 | 1,445 | 311 | 126 | 428 | 1,148 | 3,458 |
| **Private** | 184 | 607 | 245 | 553 | 41 | 2 | 1,632 | 2,530 | 106 | 809 | 1,148 | 3,458 |
| **Total** | 300 | 1,415 | 679 | 630 | 57 | 3 | 3,084 | 2,841 | 232 | 1,237 | 4,282 | 11,676 |

**Table 3.3.13 Total Pacific Coast Region Expenditures by Resident Status, 2000 (millions of dollars) (Gentner et al. 2001)**

| Pacific Coast Region | Total | Upper Bound | Lower Bound | Total | Upper Bound | Lower Bound |
|---|---|---|---|---|---|---|
| **Trip Expend** | **Residents ($)** | | | **Non- Residents ($)** | | |
| Private Transportation | 111 | 142 | 80 | 32 | 35 | 29 |
| Food | 75 | 81 | 70 | 13 | 14 | 12 |
| Lodging | 32 | 36 | 28 | 16 | 19 | 14 |
| Public Transportation | 3 | 4 | 2 | 49 | 60 | 38 |
| Boat Fuel | 46 | 51 | 40 | 3 | 4 | 2 |
| Party/Charter Fees | 64 | 70 | 58 | 8 | 9 | 6 |
| Access/Boat Launching | 10 | 11 | 9 | 1 | 2 | 1 |
| Equipment Rental | 8 | 10 | 7 | 7 | 9 | 5 |
| Bait & Ice | 31 | 34 | 27 | 3 | 3 | 2 |
| Trip Sub-Totals | 380 | 413 | 347 | 132 | 144 | 120 |
| **Annual Expenditures** | | | | | | |
| Rods & Reels | 144 | 160 | 128 | | | |
| Other Tackle | 115 | 127 | 103 | | | |
| Gear | 27 | 30 | 23 | | | |
| Camping Equipment | 16 | 21 | 11 | | | |
| Binoculars | 5 | 6 | 3 | | | |
| Clothing | 19 | 23 | 15 | | | |
| Magazines | 5 | 5 | 4 | | | |
| Club Dues | 4 | 5 | 3 | | | |
| License Fees | 72 | 78 | 66 | | | |
| Boat Accessories | 371 | 462 | 279 | | | |
| Boat Purchase | 1,066 | 1,234 | 899 | | | |
| Boat Maintenance | 304 | 343 | 266 | | | |
| Fishing Vehicle | 1,326 | 1,669 | 983 | | | |
| Fishing Vehicle Maintenance | 285 | 332 | 239 | | | |
| Vacation Home | 98 | 161 | 34 | | | |
| Vacation Home Maintenance | 103 | 199 | 8 | | | |
| Equipment & Durable Goods Sub-total | 3,959 | 4,361 | 3,546 | | | |
| All Sub-totals | 4,339 | 4,743 | 3,925 | 132 | 144 | 120 |
| Pacific Coast Region Total | 4,471 | 4,875 | 4,057 | | | |

**Table 3.3.14 Coastal Community Income Impacts for the Recreational Fishery by Area, 2001 (PFMC, 2002)**

| Area | | Charter ($1000s) | Private ($1000s) | Total ($1000s) | Jobs |
|---|---|---|---|---|---|
| Washington Coast | Total | $5,335 | $3,285 | $8,620 | 392 |
| | Groundfish | $1,134 | $385 | $1,519 | 69 |
| Oregon | Total | $6,382 | $4,911 | $11,293 | 514 |
| | Groundfish | $4,227 | $783 | $5,011 | 228 |
| California | Total | $99,616 | $135,195 | $234,811 | 8,899 |
| | Groundfish | $43,983 | $21,481 | $64,465 | 2,468 |
| Total | Total | $111,332 | $143,392 | $254,724 | 9,823 |
| | Groundfish | $48,345 | $22,649 | $70,994 | 2,765 |

### 3.3.6 Profile of the Processing Sector

With the exception of the portion of Pacific whiting catch that is processed at sea, all other Pacific coast groundfish catch is processed in shore-based processing plants along the Pacific coast. By weight, 1998 commercial shorebased groundfish landings were distributed among the three states as follows:

Washington, 24%; Oregon, 65%; California, 11%. By value, commercial groundfish landings are distributed among the three states as follows: Washington, 21%; Oregon, 46%; California, 33% (PFMC, January 2003). The discrepancies between the Oregon and California portions of the landings are expected because Oregon processors handle a relatively high percent of the shore-based whiting landings, a high volume, low value fishery. Conversely, California fishers land more of the low volume, high value species as a proportion of the total state-wide catch than Oregon fishers.

**Shorebased Sector**. Several thousand entities have permits to buy fish on the West Coast. Of these 1,780 purchased fish caught in the ocean area and landed on Washington, Oregon, or California state fish tickets in the year 2000 (excluding tribal catch) and 732 purchased groundfish. Larger volume buyers tend to handle groundfish more than smaller volume buyers. Of the 546 buyers purchasing in excess of $20,000 of West Coast landings, 59% bought groundfish. These 546 buyers bought 99% of all Council managed groundfish. Of the 1,234 buyers purchasing less than $20,000 from West Coast vessels, 33% bought groundfish. The number of buyers handling groundfish from trawl vessels is substantially lower than all of those handling groundfish. Only 17% (125) of all groundfish buyers (732) handled fish from trawl vessels. These 125 buyers comprise only 7% of all buyers (1,780). Buyers of trawl caught groundfish are important to nontrawl vessels as well, handling 60% (by value) of the groundfish caught by nontrawl vessels. Table 3.3.4.9 displays the number of buyers as compared to the groundfish buyers, grouped by total expenditures for the year 2000 ( excluding at-sea whiting).

Table 3.3.15 Number of West Coast Buyers and Groundfish Buyers in 2000 (excluding at-sea whiting)

| Buyers' Total Expenditures on West Coast Harvests | All Buyers | Nongroundfish Buyers | Groundfish Buyers | Groundfish Buyers as % of all Buyers |
|---|---|---|---|---|
| >$2 Million | 21 | 2 | 19 | 90% |
| $1-$2 Million | 33 | 14 | 19 | 58% |
| $300 Thousand - $1 Million | 98 | 36 | 62 | 63% |
| $100-$300 Thousand | 121 | 49 | 72 | 60% |
| $20-$100 Thousand | 273 | 123 | 150 | 55% |
| $5 -$20 Thousand | 372 | 224 | 148 | 40% |
| <$5 Thousand | 862 | 600 | 262 | 30% |
| Total | 1,780 | 1,048 | 732 | 41% |

The largest volume buyers tend to handle trawl vessels more than smaller volume buyers. Of the 38 largest buyers of groundfish (those with purchases in excess of $1 million), 73% (28) bought from trawl vessels Seventy-eight percent of all groundfish purchases from trawl vessels go to the 28 trawl buyers with total purchases of all species in excess of $1 million. These 28 buyers also handle 39% of the exvessel value of the nontrawl purchases.

Table 3.3.16 Number of West Coast Groundfish Buyers in 2000 by gear group (excluding at-sea whiting)

| Buyers' Total Expenditures on West Coast Harvests | Groundfish Buyers | Trawl caught groundfish buyers | Non-trawl caught groundfish buyers |
|---|---|---|---|
| >$2 Million | 19 | 17 | 2 |
| $1-$2 Million | 19 | 11 | 8 |
| $300 Thousand - $1 Million | 62 | 33 | 29 |
| $100-$300 Thousand | 72 | 23 | 49 |
| $20-$100 Thousand | 150 | 19 | 131 |
| $5 -$20 Thousand | 148 | 11 | 137 |
| <$5 Thousand | 262 | 11 | 251 |
| Total | 732 | 125 | 607 |

Mid-size buyers tend to have greater importance for nontrawl vessels than for trawl vessels. Fifty percent of all nontrawl sales go to buyers with total purchases of between $20 thousand and $1 million, as compared to 22% for trawl vessels. Absent cost and exprocessor sale price data, very rough assumptions must be made to consider possible levels of dependence of processors on groundfish. However, it is

assumed here that gross exvessel value of purchases is a rough indicator of relative levels of dependence. Large buyers of groundfish tend to have a lesser percentage of their overall purchases from groundfish than smaller buyers. Table 3.3.4.11 displays the value of purchases by west coast processors in 2000 (excluding at-sea whiting).

**Table 3.3.17 Value of Purchases by west coast buyers in 2000 (PFMC 2002)**

| | All buyers | Groundfish buyers | |
|---|---|---|---|
| | Total purchases ($1,000) | Total purchases of all species ($1,000) | Total purchases of groundfish ($1,000) |
| >$2 Million | 95,742 | 90,762 | 28,680 |
| $1-$2 Million | 45,343 | 25,851 | 8,585 |
| $300 Thousand - $1 Million | 56,115 | 36,527 | 11,278 |
| $100-$300 Thousand | 21,427 | 12,543 | 3,269 |
| $20-$100 Thousand | 12,881 | 7,297 | 2,023 |
| $5 -$20 Thousand | 3,989 | 1,519 | 501 |
| <$5 Thousand | 1,278 | 426 | 218 |
| Total | 236,775 | 174,926 | 54,554 |

**At-Sea Sector.** There are two classes of vessels in the at-sea processing sector of the whiting fishery, catcher-processors that harvest and process their own catch, and mothership vessels that process unsorted catch received from smaller catcher vessels. The processing vessels are large (>250 ft in length) and carry crews of 65-200, who mostly work in shifts to keep the factories operating day and night.

The first year of implementation of a license limitation program in the Pacific groundfish fishery was 1994. Vessels that did not initially qualify for a permit had to buy or lease one from qualifying vessels to gain access to the fishery. To harvest whiting, all at-sea catcher-processors had to purchase or lease permits. This changed the composition of the at-sea processing fleet considerably, increasing the number of motherships, because permits are not required for vessels that only process (PFMC 1998). Unlike catcher/processors and catcher vessels, motherships do not have permits to harvest groundfish in the WOC.

In 2001, 20 catcher vessels delivered whiting to five non-tribal mothership processors and four tribal catcher vessels delivered whiting to a single tribal mothership. Some vessels may deliver catch exclusively to motherships off Alaska and the West Coast, but in recent years, about half of the non-tribal vessels also delivered whiting to shore-based processing facilities in Washington, Oregon and California. Similarly, the tribal mothership also processes whiting in the non-tribal sector before the start of the tribal fishery. In 2001, seven catcher/processors participated in the whiting fishery.

Since May 1997, when the Department of Justice approved allocation of whiting shares among the members of the Whiting Conservation Cooperative, the catcher-processor fishery has operated as a voluntary quota share program where each of the catcher-processor companies has agreed to take a specific share of the harvest. With harvests assured, the catcher-processors are able to operate more cautiously to avoid areas of salmon and rockfish abundance. The motherships, however, operate under more competitive conditions (first come first served) for their sector's allocation. The U.S. whiting allocation has been fully utilized by domestic processors since 1992.

Whiting is a high volume species, but it commands a relatively low price per pound. The at-sea processing vessels have onboard surimi production capacity and were initially designed to fish for pollock in the groundfish fisheries off Alaska. Because whiting is a similar species to pollock, harvesting and processing technology and equipment used in the Alaskan fisheries is also used for whiting. In addition, to surimi, most of these vessels have the capacity to produce frozen fillet blocks and have fish meal plants to process small whiting, incidentally caught groundfish species and fish offal.